



**BOARD OF COUNTY COMMISSIONERS
WARREN COUNTY, OHIO**

406 Justice Drive, Lebanon, Ohio 45036

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Telephone (513) 695-1250

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**TOM GROSSMANN
SHANNON JONES
DAVID G. YOUNG**

22-0658

May 10, 2022

**ENTER INTO CONTRACT WITH BUILDING CRAFTS, INC. FOR THE SYCAMORE TRAILS
WASTEWATER TREATMENT PLANT UPGRADES PROJECT**

WHEREAS, pursuant to Resolution #22-0608 dated April 26, 2022, this Board approved a Notice of Intent to Award Bid for the Sycamore Trails Wastewater Treatment Plant Upgrades Project to Building Crafts, Inc., for a total bid price of \$7,149,410.00; and

WHEREAS, all documentation, including performance bonds, insurance certificates, etc., has been submitted by the contractor; and

NOW THEREFORE BE IT RESOLVED, to enter into contract with Building Crafts, Inc., 2 Rosewood Drive, Wilder, Kentucky 41076, for a total contract price of \$7,149,410.00; as attached hereto and made a part hereof.

Mr. Young moved for adoption of the foregoing resolution being seconded by Mrs. Jones. Upon call of the roll, the following vote resulted:

Mr. Grossmann – absent

Mrs. Jones – yea

Mr. Young – yea

Resolution adopted this 10th day of May 2022.

BOARD OF COUNTY COMMISSIONERS

Tina Osborne, Clerk

KP/

cc: c/a— Building Crafts, Inc.
Water/Sewer (file)
OMB Bid file



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**TOM GROSSMANN
SHANNON JONES
DAVID G. YOUNG**

22-0608

April 26, 2022

APPROVE NOTICE OF INTENT TO AWARD BID TO BUILDING CRAFTS, INC. FOR THE SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES PROJECT

WHEREAS, bids were closed at 11:00 a.m., on April 14, 2022, and the bids received were opened and read aloud for the Sycamore Trails Wastewater Treatment Plant Upgrades Project, and the results are on file in the Commissioners' Office; and

WHEREAS, upon review of such bids by Kathryn Gilbert, Staff Engineer, Building Crafts, Inc. has been determined to be the lowest and best bidder; and

NOW THEREFORE BE IT RESOLVED, upon recommendation of the Warren County Water and Sewer Department, that it is the intent of this Board to award the contract to Building Crafts, Inc., 2 Rosewood Drive, Wilder, Kentucky 41076, for a total bid price of \$7,149,410.00; and

BE IT FURTHER RESOLVED, that the President of the Board is hereby authorized to execute a "Notice of Intent to Award."

Mrs. Jones moved for adoption of the foregoing resolution being seconded by Mr. Young. Upon call of the roll, the following vote resulted:

Mr. Grossmann – yea

Mr. Young – yea

Mrs. Jones – yea

Resolution adopted this 26th day of April 2022.

BOARD OF COUNTY COMMISSIONERS

Tina Osborne, Clerk

cc: Water/Sewer (file)
OMB Bid file



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***TOM GROSSMANN
SHANNON JONES
DAVID G. YOUNG***

BID OPENING

April 14, 2022

BID OPENING –

Bids were closed at 11:00 a.m. this 14th day of April and the following bids were received, opened, and read aloud for the Sycamore Trails Wastewater Treatment Plant Upgrades Project for the Warren County Water and Sewer Department.

Kirk Bros. Co., Inc. Findlay, OH	\$8,213,000.00
Dugan and Meyers Louisville, KY	\$8,308,000.00
Building Crafts Wilder, KY	\$7,149,410.00

Kathryn Gilbert, Staff Engineer, will review bids for a recommendation at a later date.

cc: Bid File

OMB

W/S (file)

ADDENDUM NO. 2

PROJECT MANUAL

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
CONTRACT 1-2021
WARREN COUNTY BOARD OF COMMISSIONERS
WARREN COUNTY, OHIO

Bids will be received until April 14, 2022, at 11:00 AM, local time.

This Addendum to the Project Manual is issued to modify, explain, or correct the original Project Manual and is hereby made part of the Contract Documents. Insert the number of this Addendum in the blank space provided in the Bid Proposal, page 00 10 20-1.

A. DIVISION 00–BIDDING AND CONTRACTING REQUIREMENTS

1. SECTION 00 10 10–INVITATION TO BIDDERS

a. Page 00 10 10-1

CHANGE the estimated contract value from “\$5,933,000” to “\$6,500,000.”

2. SECTION 00 10 30–BID FORM

a. Page 00 10 30-1

REPLACE Bid Page 00 10 30-1 with the attached **Revised** Bid Page 00 10 30-1.

3. SECTION 00 10 40–BID EQUIPMENT AND COMPONENTS

a. Pages 00 10 40-1 and 00 10 40-2

REPLACE Bid Pages 00 10 40-1 and 00 10 40-2 with the attached **Revised** Bid Pages 00 10 40-1 and 00 10 40-2.

4. SECTION 00 20 00–GENERAL INSTRUCTIONS TO BIDDERS

a. Page 00 20 00-1, 2. Description of Project

CHANGE the estimated contract value from “\$5,933,000” to “\$6,500,000.”

b. Page 00 20 00-1, 3. Construction Cost

CHANGE the estimated cost from “\$5,933,000” to “\$6,500,000.”

B. SPECIFICATIONS

1. DIVISION 02–EXISTING CONDITIONS

a. Page 02 54 16-1, SECTION 02 54 16–TANK MATERIAL REMOVAL, DISPOSAL, AND CLEANING

ADD the attached Section 02 54 16–Tank Material Removal, Disposal, and Cleaning to these

Specifications.

2. DIVISION 08—OPENINGS

a. Page 08 33 23-1, SECTION 08 33 23—OVERHEAD COILING DOORS

ADD the attached Section 08 33 23—Overhead Coiling Doors to these Specifications.

3. DIVISION 26—ELECTRICAL

a. Page 26 24 19-8, SECTION 26 24 19—MOTOR CONTROL, PART 2—PRODUCTS, 2.04.F.

DELETE Paragraph 2.04.F. in its entirety.

4. DIVISION 33—UTILITIES

a. Page 33 00 10-8, SECTION 33 00 10—BURIED PIPING AND APPURTENANCES, PART 2—PRODUCTS, 2.03.I.3.

ADD the following after Paragraph 2.03.I.3.:

“K. Sump Pump Pressure Sewer Pipe and Fittings (Less Than 4 Inches):

1. Sump pump pressure sewer pipe and laterals shall be constructed of PVC conforming to ASTM D1785 for Schedules 40, SDR 17 with solvent weld joints.
2. All fittings shall be solvent weld, 1120 PVC, Schedule 40 conforming to ASTM D2466.
3. All fittings and joints shall have a working pressure rating at least equal to the pipe to which they are attached. Fittings shall be compatible with the above specified SDR PR or Schedule Pipe. All PVC fittings outside of manholes shall have socket or bell ends. Transitions to curb stops shall be socket type on the PVC side and threaded on the curb stop side. Fittings inside manholes shall be as shown on the Drawings. All PVC pipe and fittings shall be approved by the National Sanitation Foundation and shall bear their mark of approval.
4. Provide tracer wire as specified.”

5. DIVISION 40—PROCESS INTERCONNECTIONS

a. Page 40 05 00-2, SECTION 40 05 00—PIPING AND APPURTENANCES, PART 2—PRODUCTS, 2.02.A.4.

DELETE Paragraph 2.02.A.4. in its entirety.

b. Page 40 05 00-8, SECTION 40 05 00—PIPING AND APPURTENANCES, PART 2—PRODUCTS, 2.04.C.2.

DELETE the first sentence of the paragraph in its entirety.

C. DRAWINGS

1. SHEET NO. 13—SITE OVERALL YARD PIPING PLAN

CHANGE piping from sump pump discharge at Structure 50 to Structure 80 wet well from “4” D” ductile iron pipe to “3” D” PVC piping.

CLARIFICATION: Site piping for the sump pump discharge in the RAS Valve Vault shall be 3-inch PVC piping, as shown on Sheet No. 34.

2. SHEET NO. 34–RAS/WAS PUMP STATION AND VALVE VAULT PLANS, SECTIONS, AND DETAILS

CHANGE callout “3” SPD TO RAS/WAS PUMP STATION” to “3” D TO PLANT DRAIN PUMP STATION WET WELL.”

CLARIFICATION: Sump pump discharge piping routing shall be as shown on Sheet No. 13, discharging to the Structure 80 wet well.

3. SHEET NO. 37–PLANT DRAIN PUMP STATION AND VALVE VAULT PLANS, SECTIONS, AND DETAILS

CLARIFICATION: Sump pump piping from the RAS/WAS valve vault shall be PVC.

4. SHEET NO. 46–SCHEDULES AND DETAILS

ADD “J” as the “FRAME TYPE” for Doors 5001, 8001, and 2001.

D. CLARIFICATIONS FOR QUESTIONS

The following is a list of clarifications regarding Project documents. These clarifications include questions received during the Advertisement period:

Q: How are solids quantities to be removed being determined?

A: This is addressed in the addendum.

Q: For Plug Valves and Checks with Mfg. (Dezurik) on Plugs and (AVK) on Check, will other Mfg. be allowed to quote under the “Or Equal” status if they meet the spec. ?

A: Or equal to be considered after the bid.

Q: Please confirm material of 12” RW, is it PVC or DIP (Is there a pipe schedule?)

A: RW pipe shall be solid wall PVC.

Q: Please confirm you wish to utilize “MJ” ductile iron pipe for all dip yard piping. MJ pipe is no commonly used and can be hard to get. TR-Flex pipe is more common and more cost effective. If restraint is not needed can push joint pipe be utilized, like Tyton Joint?

A: Push on joints are acceptable. Joints requiring restraint as specified may be mechanical joint or may be restrained as noted in 2.03A4.

Q: A specification section 11 53 00 – Laboratory Furniture and Equipment is included with the documents. We find no lab furniture or equipment shown on the drawings. Was this specification section included in error?

A: Furniture listed in this spec is included in the drawings. See Drawing 30-ASM1.02.

Q: Are there structural drawings of the existing tankage that can be made available by Addendum?

A: The existing drawings are posted on the County bidding website under “Previous Record Drawings.”

Q: Reference specification section 26 09 00, Paragraph 1.02, B. Please confirm it is the intent that one System Supplier shall supply all components described in the paragraph. It is not acceptable deviate from this paragraph to have Electrician supply MCC, separate instrument supplier, separate integrator, etc.

A: It is the intent that one System Supplier shall supply all components described in the paragraph.

Q: Bid form 00 30 50 -4 is a certificate of compliance non-discrimination and equal employment opportunity affidavit (sub contractor). Please confirm this form is to be submitted after award.

A: This certificate is to be submitted after award.

Q: The site will require clearing of trees to be performed to build the aeration tank and blower pad and the electrical building. How will the project schedule deal with this tree removal restriction?

A: No tree removal restrictions that are impacting this project at this time.

**BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE
SPACE PROVIDED IN THE BID FORM**

Dated at Cincinnati, Ohio
April 11, 2022

STRAND ASSOCIATES, INC.®
615 Elsinore Place, Suite 320
Cincinnati, OH 45202



Math. Smith
4/11/2022

**SECTION 00 10 30
 BID FORM**

BIDDER agrees to perform all the work described in the Contract Documents for the following prices:

Item	Description	Quantity	Unit	Amount
1	Base Bid	1	L.S.	
2	Electrical Service Allowance	1	L.S.	\$15,000.00
3	Testing Services Allowance Section 31 23 00–Excavation, Fill, Backfill, and Grading	1	L.S.	\$15,000.00
4	Furnishing Allowance (to be directed by OWNER)	1	L.S.	\$10,000.00
5	Local Wireless Access Point Equipment and Tablet	1	L.S.	\$6,000.00
6	Sludge Removal and Dewatering Allowance Section 02 54 16	5.10	DRY TONS	

Total of Bid Items 1 through 6 \$ _____

Total Bid Items 1 through 6 (In Words)

Bidder's Name

L.S. = Lump Sum

SECTION 00 10 40
BID EQUIPMENT AND COMPONENTS

BIDDER shall indicate by placing an "X" in the "()" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for this category of equipment or component identified by product name and specification number.

For the submersible pumps, coarse bubble mixing assemblies and ultraviolet disinfection system, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter deducts to the Bid Form sum for alternative equipment, as noted in each category below.

BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications will be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	Product Manufacturer or Supplier
Launder Cover System (Section 06 60 12)	<input type="checkbox"/> a. NEFCO Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Controls and Instrumentation (Section 26 09 00)	<input type="checkbox"/> a. Frakes Engineering <input type="checkbox"/> b. Integrated Process Solutions <input type="checkbox"/> c. Wunderlich-Malec <input type="checkbox"/> d. Automated Systems Engineering <input type="checkbox"/> e. BSI <input type="checkbox"/> f. Jacobs
Tri-Lobe Positive Displacement Blowers (43 11 33)	<input type="checkbox"/> a. Aerzen Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Submersible Pumps (43 25 10)	<input type="checkbox"/> a. Ebara Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____

Mechanical Fine Screen (46 21 13)	<input type="checkbox"/> a. Kusters <input type="checkbox"/> b. Huber Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Secondary Clarifier Collectors (46 43 21)	<input type="checkbox"/> a. Ovivo <input type="checkbox"/> b. WesTech <input type="checkbox"/> c. Evoqua Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Coarse Bubble Mixing Assemblies (46 51 21)	<input type="checkbox"/> a. Tideflex Technologies Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Membrane Diffusers (46 51 46)	<input type="checkbox"/> a. Sanitaire <input type="checkbox"/> b. Aquarius Technologies Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Ultraviolet Disinfection System (46 66 56)	<input type="checkbox"/> a. Trojan Technologies <input type="checkbox"/> b. Wedeco Inc. Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____

SECTION 02 54 16

TANK MATERIAL REMOVAL, DISPOSAL, AND CLEANING

PART 1—GENERAL

1.01 SUMMARY

A. Work Included:

1. The Work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the removal, handling, and disposal of sludge, biosolids, and other materials and debris in the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank. "Sewage sludge" or "sludge" or "biosolids" means the solid, semi-solid or liquid residue generated during the treatment of wastewater solids. "Debris" means material such as wood, grit, sand, stones, mud, brick, tools, metals, and plastic items that have accumulated in the tanks. The character of the waste can be from a flowable semi-solid to a heavy, thick, pasty, or gritty semi-liquid or solid. The tank material can be in active decomposition and producing carbon monoxide, hydrogen sulfide, and other potentially deleterious and/or harmful gases that may provide a lack of oxygen. The Work also includes cleaning of the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, dosing tank, and cleaning and removal of any blockages (if required) of wastewater and aeration piping in each structure.
2. The Work includes removing any remaining wastewater, sludge, grit, rags, and other accumulated debris that is currently contained in the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank. CONTRACTOR shall be responsible for notification of OWNER in advance of tank material removal and disposal. CONTRACTOR shall coordinate disposal volumes and schedule with the OWNER. OWNER shall pay fees incurred with disposal at the landfill and arrange for permits as required.
3. CONTRACTOR is responsible for pressure washing the tanks, including walls and floors, to remove scum, grease, rags and other materials found and to allow performance of other work.
4. CONTRACTOR may handle and dispose of material removed from the tanks in a liquid form or may provide temporary dewatering equipment for the dewatering of material removed from each structure. If CONTRACTOR elects to provide temporary dewatering equipment, CONTRACTOR shall be responsible for providing all pumps and piping to transport materials to the temporary dewatering equipment including equipment such as a nurse tank, screening equipment, grinding equipment, and repumping. CONTRACTOR shall provide polymer feed equipment and shall be responsible for all polymer and operation and maintenance costs.

B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section. Construction sequence shall generally be as indicated in Section 01 11 00. Subsequent removal of all remaining material and tank cleaning shall be provided by CONTRACTOR. It is expected that a combination of raw sludge, scum, dirt, sand, rocks, grit, rags, and other debris and residue will remain. All remaining material shall be removed, dewatered, hauled, and disposed of by CONTRACTOR.

C. Allowances: CONTRACTOR shall INCLUDE in the Bid the total cost of removing 5.10 tons of dry weight content sludge from the tanks. Anticipated dry weight contents for each

structure are included for reference below, but CONTRACTOR is to submit bid per pound of dry weight sludge as defined in this section. Payment to CONTRACTOR will be adjusted, add or deduct, based upon the actual dry weight content of the sludge remaining in the tanks (more or less than 5.10 tons). CONTRACTOR shall be responsible for testing and reporting to the ENGINEER the dry weight content of each load transported to the landfill.

Structure	Anticipated Dry Weight Content of Tank Material (tons)
Aeration Tanks 1 and 2 (total)	3.64
Sludge Holding Tank	0.50
Mechanical Clarifiers	0.48
Upflow Clarifiers	0.34
Dosing Tank	0.15
Total	5.10

D. Background: Influent into the aeration tanks is directed between two extended aeration tanks before entering the mechanical clarifier. Forward flows pass through the mechanical clarifier before going to the upflow clarifier. Return and waste activated sludge exit through the sludge hoppers and are pumped back into the aeration tanks (RAS) or to the sludge holding tank (WAS). The aeration tanks, upflow clarifiers, and dosing tanks were originally constructed in 1978, the sludge holding tank was added in 1993, and the mechanical clarifier was added later in 1998.

E. Mobilization, demobilization, and tank cleaning shall be included in the Allowance.

1.02 SUBMITTALS

A. A minimum of 30 days prior to the removal, dewatering (if CONTRACTOR elects), hauling, and disposal of remaining material, CONTRACTOR shall submit a work plan to ENGINEER and OWNER for review.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL

A. It is CONTRACTOR's responsibility to provide all means, methods, procedures, and safety precautions for the removal of all debris and biosolids from the existing tanks.

B. CONTRACTOR shall place equipment, vehicles, and temporary piping so that it does not interfere with plant operations or the ongoing construction activities at the plant. CONTRACTOR shall coordinate site use with OWNER in advance

3.02 DEBRIS AND BIOSOLIDS REMOVAL AND DISPOSAL

- A. CONTRACTOR is responsible for removing all water that is necessary to allow biosolids removal and cleaning of the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank.
- B. It is the CONTRACTOR's responsibility to provide all means, methods, procedures, and safety precautions for the removal of all debris and biosolids from the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank.
- C. All tank materials removed and dewatered by CONTRACTOR shall be disposed of at a landfill. CONTRACTOR is responsible for proper and safe transportation of the material to the landfill. Material removed shall be disposed of in strict accordance with all local, state, and federal rules and regulations.
- D. Nonpotable water for CONTRACTOR's use will be allowed from the hydrant between the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank. CONTRACTOR may tap plant service water hydrants and shall boost water pressure if required by CONTRACTOR for dewatering and cleaning operations.
- E. If CONTRACTOR elects to provide temporary dewatering equipment, CONTRACTOR may return filtrate or centrate from dewatering operations to the head of the wastewater treatment plant through the plant drainage system. CONTRACTOR shall provide temporary wash water supply and electrical service. Minimum solids capture shall be 95%. The rate of filtrate or centrate return shall be limited to 100 gpm because of the anticipated high ammonia concentrations. CONTRACTOR shall provide temporary filtrate storage and/or reduce the return rate of filtrate or centrate so plant permit limits are met.
- F. Work shall be performed in accordance with the schedule submitted by CONTRACTOR and approved by OWNER. CONTRACTOR shall provide labor and equipment required to continue removal, dewatering (if CONTRACTOR elects), and disposal of contents and to continue cleaning operations. During freezing conditions, CONTRACTOR shall provide for heating discharge material and air purging of discharge lines.
- G. CONTRACTOR shall conduct work in a way as to minimize odors 24 hours a day while emptying and cleaning the tank.
- H. OWNER reserves the right to stop or postpone the work if odors 24 hours a day while emptying and cleaning the tank.
- I. OWNER reserves the right to stop, or postpone the work if odors become objectionable or if there are other adverse impacts on plant operations due to removal of contents, dewatering (if CONTRACTOR elects), dewatered biosolids storage or disposal, or cleaning. No additional compensation will be paid to CONTRACTOR because OWNER stops or postpones the removal, dewatering (if CONTRACTOR elects), storage, disposal, or cleaning work for odors or other adverse impacts on plant operations.
- J. CONTRACTOR shall take all necessary safety and other precautions when taking the existing aeration tanks, sludge holding tank, mechanical clarifier, upflow clarifiers, and dosing tank out of service. CONTRACTOR shall coordinate taking these processes out of service with OWNER. Entry work shall be in conformance with all local, state, and federal regulations.

- K. All hoses, ladders, pumps, and other material and equipment for completing the cleaning operations and subsequent OWNER observation shall be provided by CONTRACTOR. Provide all pumps, temporary piping, and appurtenances to remove spent wash water from the structures and discharge it to a point approved by OWNER.
- L. CONTRACTOR shall place his equipment, vehicles, and temporary piping so that it does not interfere with plant operations.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes insulated overhead coiling door with manual operation, operating hardware, and supports.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

PART 2—PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal: Overhead Door Co. Series 625 Insulated Stormtite door, Raynor Series IF, or equal.

2.02 MATERIALS

- A. Curtain:
 - 1. Curtain slats shall be Type F-265I flat crown, pitch 2 5/8 inches, 22 gauge galvanized steel. Back cover shall be 24 gauge galvanized steel.
 - 2. Slat system shall be integral and foamed in place with polyurethane foam nominal 2-pound density applied between the slat and back cover, rising to bond the slat and back cover into an integral member with a thickness of 3/4 inch.
 - 3. End locks shall be used on alternate slats. Provide wind locks as required for 25 psf design wind load.
- B. Bottom Bar: The bottom bar shall be two galvanized steel angles, minimum thickness 1/8 inch, bolted back-to-back to reinforce the curtain in the guides, and have a loop-type weather seal.
- C. Guides:
 - 1. Guides shall be three structural steel galvanized steel angles with a minimum thickness of 3/16 inch.
 - 2. Guides shall be equipped with full door height PVC weather seals contacting the exterior and interior curtain surfaces to minimize air flow.
 - 3. Guides shall be insulated full height and shall be equipped with wind lock bars to meet 25 psf design wind load.

- D. Brackets:
 - 1. Brackets shall be minimum 3/16-inch-thick steel plate to support the barrel, counterbalance, and hood.
 - 2. Provide intermediate support brackets as necessary.
- E. Counterbalance:
 - 1. Counterbalance shall be helical torsion springs housed in a steel pipe barrel, supporting the curtain with a deflection limited to 0.03 inch per foot of width.
 - 2. Counterbalance shall be adjustable by means of an external adjusting tension wheel and designed for minimum 20,000 cycles.
- F. Hood:
 - 1. The hood shall be 24 gauge galvanized steel minimum.
 - 2. The hood shall have an internal baffle and an external lintel baffle to retard air infiltration.
- G. Locking: Manual chain hoist-operated doors shall have chain-keeper locks suitable for padlocking.
- H. Manual Operator: Chain hoist.

2.03 FINISHES

- A. The curtain and hood shall receive a UV-resistant powder-coat finish with color selected from manufacturer's standard colors.
- B. All nongalvanized, exposed ferrous surfaces shall receive one coat of manufacturer's standard factory-applied rust-inhibitive primer compatible with field paint.
- C. All nongalvanized, ferrous surfaces that will become inaccessible after installation shall be finish painted as specified in Section 09 91 00–Painting prior to installation.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Door shall be installed in accordance with manufacturer's instructions and standards by an authorized representative.
- B. Upon completion of installation, operating devices and controls shall be adjusted and lubricated to operate properly.

3.02 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

ADDENDUM NO. 1

PROJECT MANUAL

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
CONTRACT 1-2021
WARREN COUNTY BOARD OF COMMISSIONERS
WARREN COUNTY, OHIO

Bids will be received until April 14, 2022, at 11:00 AM, local time.

This Addendum to the Project Manual is issued to modify, explain, or correct the original Project Manual and is hereby made part of the Contract Documents. Insert the number of this Addendum in the blank space provided in the Bid Proposal, page 00 10 20-1.

A. DIVISION 00–BIDDING AND CONTRACTING REQUIREMENTS

1. SYCAMORE TRAILS PRE-BID MEETING REGISTER

ADD the attached Meeting Register from the Pre-Bid Meeting.

2. SECTION 00 20 00–GENERAL INSTRUCTIONS TO BIDDERS

a. Page 00 20 00-1, 5. Time of Completion and Liquidated Damages

CHANGE Substantial completion to “720 days from Notice to Proceed.”

CHANGE Final completion to “780 days from Notice to Proceed.”

3. SECTION 00 60 10–CONTRACT

a. Page 00 60 10-1

CHANGE Substantial completion to “720 days from Notice to Proceed.”

CHANGE Final completion to “780 days from Notice to Proceed.”

B. SPECIFICATIONS

1. DIVISION 01–GENERAL REQUIREMENTS

a. Replace SECTION 01 11 00–summary of work, in its entirety, with the attached.

b. Page 01 41 00-1, SECTION 01 41 00–REGULATORY REQUIREMENTS,
PART 1–GENERAL, 1.01.A.5.

ADD the following after Paragraph 1.01.A.4.:

“5. Buy American Requirements.”

c. Page 01 41 00-1, SECTION 01 41 00–REGULATORY REQUIREMENTS,
PART 1–GENERAL, 1.04.A.4.

DELETE Paragraph 1.04.A.4. in its entirety.

- d. Page 01 41 00-1, SECTION 01 41 00–REGULATORY REQUIREMENTS, PART 1–GENERAL, 1.06.

ADD the following Section after Section 1.05.:

“1.06 BUY AMERICAN REQUIREMENTS

- A. All construction materials, including aggregates, concrete, pipe and valves shall be manufactured in the United States.”

2. DIVISION 02–EXISTING CONDITIONS

- a. Pages 02 41 00-1 through 02 41 00-5, SECTION 02 41 00–DEMOLITION

ADD the attached Section 02 41 00–Demolition to these Specifications.

3. DIVISION 04–MASONRY

- a. Page 04 20 00-4, SECTION 04 20 00–UNIT MASONRY SYSTEM, PART 2–PRODUCTS, 2.04.D.

ADD the following paragraph after Paragraph 2.04.D.:

- “E. Brick supports at lintels shall be Thermal Brick System (TBS) by Hohmann & Barnard, Inc., or equal.”

4. DIVISION 07–THERMAL INSULATION AND MOISTURE PROTECTION

- a. Page 07 61 00-1, SECTION 07 61 00–SHEET METAL ROOFING

DELETE Section 07 61 00–Sheet Metal Roofing, in its entirety.

- b. Page 07 31 13-1, SECTION 07 31 13–ASPHALT SHINGLE ROOFING

ADD the attached Section 07 31 13–Asphalt Shingle Roofing to these Specifications.

5. DIVISION 32–EXTERIOR IMPROVEMENTS

- a. Page 32 31 13-1, SECTION 32 31 13–CHAIN LINK FENCE

ADD the attached Section 32 31 13–Chain Link Fence to these Specifications.

6. DIVISION 33–UTILITIES

- a. Page 33 00 10-7, SECTION 33 00 10–BURIED PIPING AND APPURTENANCES, PART 2–PRODUCTS, 2.03.F.1.

REPLACE “2-inch” with “3-inch” in Paragraph 2.03.F.1.

- b. Page 33 00 10-8, SECTION 33 00 10–BURIED PIPING AND APPURTENANCES, PART 2–PRODUCTS, 2.03.I.

ADD the following paragraphs after Paragraph 2.03.I.:

“J. Perforated Piping:

1. Perforated pipe and fittings shall be heavy-duty corrugated polyethylene conforming to ASTM F405 and ASTM F667. Pipe and fittings shall be provided as shown on the Drawings and in accordance with ASTM F449.
2. Adapters with band seals shall be provided when joining with pipe of different materials.
3. Pipe shall be as manufactured by Advance Drainage Systems, Inc., Hancor, Inc., or equal.
4. See detail on Drawings for laying conditions.
5. Fabric shall be provided in accordance with manufacturer’s instructions. Minimum lap shall be 18 inches. All laps shall be tacked or pinned to prevent separation during installation.”

7. DIVISION 46–WATER AND WASTEWATER EQUIPMENT

- a. Page 46 21 13-2, SECTION 46 21 13–MECHANICAL FINE SCREEN, PART 2–PRODUCTS, 2.01.B.

CLARIFICATION: Engineering changes include changes associated with widening the channel to accommodate the Huber screen, which requires a channel width of 20-inches.

C. DRAWINGS

1. SHEET NO. 8–DEMOLITION PLAN–PHASE 1

DELETE General Note 1 in its entirety.

2. SHEET NO. 11–SITE OVERALL LOCATION PLAN

CLARIFICATION: Swing gate on chain link fence shall be 16 feet wide as shown on detail noted in Key Note 1.

REPLACE “NO SCALE” with “1-IN = 200-FT” on detail B/05-C1.01 MILLING AND RESURFACE detail.

ADD the following Key Note:

“8. PROVIDE A SWING GATE WITH A MINIMUM WIDTH OF 3'-5.”

ADD callout for Key Note 8 on fence line, approximately 8'-0” south of Structure 90.

ADD the attached detail NEW PAVEMENT SECTION.

3. SHEET NO. 12–OVERALL GRADING AND EROSION CONTROL PLAN

CLARIFICATION: New utility transformer is not shown in the correct location on Sheet 12. The correct location of the new utility transformer is to be provided as shown on the 05-E1.01 OVERALL ELECTRICAL SITE PLAN. New utility transformer shall be placed on existing utility transformer pad.

4. SHEET NO. 13—OVERALL YARD PIPING PLAN

REPLACE the RAS VALVE VAULT “6x13” Structure Size in the Structure Identification table with “6.67 x 11.67.”

ADD the following two rows to the Structure Identification Table:

AEW-4	NEW	-	939.07	12” AEW	ODOT HW-2.2 W/OUTLET CHANNEL PROTECTION	-
AERATION TANK VALVE VAULT	NEW	950.01	934.37	7 X 13.33	VALVE MANHOLE	SEE SPECIFICATIONS

ADD label “AEW-4” to 12” FE Discharge Pipe.

REPLACE General Note 11 with the following:

“INSTALL FENCE 5” ABOVE GROUND LEVEL.”

ADD the following Key Note:

“11. FITTINGS SHALL BE PROVIDED AS NECESSARY TO ROUTE 3" PW LINE TO THE EAST OF THE TRANSFORMER PAD. PW LINE SHOULD BE A MINIMUM OF 5' EAST OF THE TRANSFORMER PAD. PW LINE SHALL NOT BE PLACED BENEATH EXISTING TRANSFORMER PAD.”

ADD Key Note 11 callout pointing to 3” PW line near the utility transformer.

CHANGE detail callout in General Note 3 from “99-C5.03” to “99-ASM5.03.”

5. SHEET NO. 18—AERATION TANKS PLAN AND DETAILS

CLARIFICATION: Provide plug valves and 4” SCM/D piping as shown on Drawing 05-M1.01 OVERALL YARD PIPING PLAN. Only one plug valve is to be provided at the 4” SCM/D discharge to the influent splitter structure.

CHANGE 2” SAM centerline elevation from “963.85” to “953.85.”

CLARIFICATION: Buried air piping in Condensate Blowoff Detail C/20-ASME1.01 should use mechanical joint fittings.

ADD the following Key Note:

“25. PROVIDE SS EXTENSION STEM AND SS GUIDES. MAXIMUM SPACING BETWEEN GUIDES SHALL BE 5 FEET. SS VALVE OPERATOR NUT SHALL BE ACCESSIBLE FROM GROUND SURFACE WITHOUT ENTERING VALVE VAULT. PROVIDE FLOOR BOX WITH COVER FOR VALVE OPERATOR NUTS (TYP. OF 3).”

ADD Key Note callout 25 adjacent to Valve Box and Actuating Nut Note.

ADD the following Key Note:

“26. PROVIDE PRECAST STRUCTURE FOR AERATION TANK VALVE VAULT. INTERIOR BOTTOM OF CASTING SHALL BE AT ELEVATION 933.37. SEE STRUCTURE IDENTIFICATION TABLE ON SHEET 13-05-M1.01. FOR ADDITIONAL DETAILS.”

ADD Key Note callout 26 to the aeration tank valve vault.

6. SHEET NO. 19–AERATION TANKS SECTIONS

CHANGE base slab elevation callout for the effluent channel in Section 3/20-ASM3.01 from “EL. 941.20” to “EL. 945.33.”

7. SHEET NO. 33–SECONDARY CLARIFIERS SECTIONS AND DETAILS

a. Page 46 21 13-2, SECTION 46 21 13–MECHANICAL FINE SCREEN, PART 2–PRODUCTS, 2.01.B.

8. SHEET NO. 34–RAS/WAS PUMP STATION AND VALVE VAULT PLANS, SECTIONS, AND DETAILS

CHANGE “13-FT” to “11.67-FT” in the VALVE MANHOLE INTERIOR LENGTH (MIN) of the Pumping Station Elevations Table.

CHANGE “6-FT” to “6.67-FT” in the VALVE MANHOLE INTERIOR WIDTH (MIN) of the Pumping Station Elevations Table.

9. SHEET NO. 46–SCHEDULES AND DETAILS ELECTRICAL BUILDING

DELETE Key Note 1.

D. CLARIFICATIONS FOR QUESTIONS

The following is a list of clarifications regarding Project documents. These clarifications include questions received during the Advertisement period:

Q: Section 26 09 00–1.08.H.3–Half of the System Suppliers listed in Section 26 09 00 1.08.I are engineering firms with in-house design-only capabilities. As such they do not stock spare parts. Usually it is up to a distributor to stock these parts. Is that acceptable since a list of required spare parts that will be supplied under contract are listed in Section 26 95 10?

A: Yes, this is acceptable.

Q: Section 26 09 00–1.08.H.8–Has the HMI software been specified?

A: HMI software is specified in 26 09 00 2.13.C.

Q: At the Aeration Tanks it shows a concrete fill underneath the influent splitter box and the effluent trough. Given the rock elevations at the Aeration Tank the splitter box is near the bottom of the Aeration Tank splitter box there is only a limited portion of the splitter box that will be undermined by the Aeration Tank excavation. Are we supposed to overexcavate for the entire Aeration Tank splitter box all the way down to the Aeration Tank subgrade and fill with concrete or can we just have a smaller portion of the splitter box undermined by the Aeration Tank excavation and fill that area with concrete?

A: Overexcavation below the aeration splitter box and channel is not required.

Q: The Aeration Tank drawings show the effluent trough at an elevation of 941.2, but when you scale the wall height it shows the slab elevation closer to 945. Please confirm the elevation for the effluent trough.

A: This is addressed in the addendum.

Q: There is a vault shown on 18 at the Aeration Tanks that is 13'-4"x7'. This vault is not shown on drawings 11, 12. There is not a specific drawing showing how this structure is to be built or showing the piping in the vault. We're assuming this vault is a precast vault. Please provide more information on this vault.

A: Additional information on this structure is provided in the addendum. This valve vault is intended to be precast.

Q: Please provide the flowrates required for bypassing the influent line while it's be temporarily located for the construction of the Aeration Tank.

A: See specification Section 33 01 31 Sewer Bypass Pumping. Part 3-3.01 lists bypass pumping flows.

Q: Can the clarifiers be poured in 1 pour or are we required to pour them in halves or quarters?

A: Clarifier base slabs may be constructed without joints. Provide joints as shown and specified in walls.

Q: Does the stone mulch areas count as driveway areas that require granular fill underneath them from structure excavations and for pipeline backfills?

A: Stone mulch does not count as driveway areas.

Q: Is the award of the project just off the base bid equipment or will proposed deductive alternates for equipment be used in the evaluation of the lowest and best bid for the project?

A: Award of project is based on base bid equipment. Deductive alternatives will be considered after award of bid.

Q: Are rock cores going to be provided?

A: Rock cores are not going to be provided. Information in geotechnical reports can be used for rock removal evaluation and costs shall be incidental to the total project cost.

Q: Are American Iron and Steel (AIS) requirements applicable to this contract?

A: Construction materials used shall be domestic, made in the United States of America.

Q: Refer to Section 01 11 00, Paragraph 1.04.B.5, concerning draining liquid and removing solids from exiting process tanks and structures. It is our understanding the contractor can transfer liquid to the new Influent Screening Station except for mixed liquid which shall be transferred to the new Aeration Tanks. If this is incorrect clarify by addendum

A: All liquid must be put through the screening structure before it flows into the new aeration tanks. Mixed fluid should also first go through the new screening structure.

Q: Refer to Section 01 29 00, Paragraph 1.03, concerning field testing. It is our understanding that all field testing, including concrete, masonry, earthwork and asphalt testing, is included in the allowance. If this is incorrect clarify by addendum.

A: This allowance does not include the masonry and concrete testing.

Q: Will blasting be allowed to break bedrock on the project site?

A: Blasting will not be allowed, due to the presence of nearby existing structures that could be impacted by blasting.

Q: Refer to Sheet 8, General Note 3, concerning Section 02 41 00. We cannot locate this section therefore it is our understanding it is not part of the contract documents. If this is incorrect clarify by addendum.

A: This is being addressed in the addendum.

Q: Refer to Sheet 8, Demolition Note B, concerning demolition of Sludge Drying Beds. It is our understanding the Contractor can use the filter sand and gravel on the site. If this is incorrect clarify by addendum.

A: The sand and gravel from the filters can be used but reference the phases and construction sequence in section 01 11 00 SUMMARY OF WORK for when this can occur.

Q: Refer to Sheet 11, concerning new pavement. Please provide the pavement section (i.e. thickness of aggregate base and thickness of asphalt base, intermediate & surface courses) for new pavement by addendum.

A: This is addressed in the addendum.

Q: Refer to Sheet 13, Key Note 7, concerning Chemical Phosphorous Removal Equipment. It is our understanding this equipment is to be furnish and installed by others and is not part of the project. If this is incorrect clarify by addendum.

A: The equipment is by others and not a part of this project.

Q: Refer to Sheet 22, concerning the gutter discharge piping and 6" D, and Sheet 13, Notes 9, concerning 6" D. It is our understanding all of the gutter discharge piping and 6" D is to be solid (except at retaining wall it shall be slotted) wall HDPE in accordance with Section 32 32 16, Paragraph 2.07. If this is incorrect clarify by addendum.

A: This is correct.

Q: Refer to Sheet 22, Key Note 7, concerning underground plumbing. It is our understanding that underground plumbing does not require concrete encasement. If this is incorrect clarify by addendum.

A: Plumbing is not required to be encased, except where it passes below foundation footing, where it should be locally encased in concrete for the width of the footing.

Q: Refer to existing record/as-built drawings, concerning top of concrete elevations at structures. It appears the top of concrete elevations on Sheet 4 of 14 in the 1978 drawing set do not match the actual site conditions. The top of concrete elevations on Page 5 of 7 in the 1998 drawing set have a different datum and do not provide a conversion. Please provide the actual top of concrete elevations by addendum.

A: Additional information issued as part of addendum.

Q: Refer to Section 33 00 10, 2.03.A.1, concerning Special Thickness Class 53 for buried ductile iron pipe. Can special thickness classes (i.e. 50) or pressure classes (i.e. 350) which meet the minimum pressure rating of 250 psi be acceptable for buried ductile iron pipe on the project?

A: No. Ductile iron pipe shall be as specified.

Q: Refer to Section 33 00 10, concerning joint restraint. It is our understanding the only buried services that require joint restraint are as follows:

- A. Air (A)
- B. Potable Water (PW)
- C. Non-Potable Water (NPW)
- D. RAS/WAS Pump Station Discharges (RAS/WAS, RAS & WAS)
- E. RAS/WAS Valve Vault Sump Pump Discharge (D)
- F. Plant Drain Pump Station Discharge (FM & SCM/D)

If this is incorrect clarify by addendum.

A: Refer to specification Section 33 00 10 3.01.A.2. to determine piping that should have joint restraints and the distance from fittings necessary for joint restraint.

Q: Refer to Sheet 13 concerning the 3" PW line. It is our understanding Copper or HDPE Water Piping may be used.

A: This is addressed in the addendum.

Q: Refer to Sheet 13, concerning the 3" PW line which is routed under the existing transformer pad. If the existing transformer pad is to remain clarify the potable water route by addendum.

A: This is addressed in the addendum.

Q: Refer to Sheet 13, Section 1, concerning valves. This detail shows five (5) manual plug valves at the blower pad. However, Sheet 7 shows eight (8) manual plug valves and three (3) motor operated valves. It is our understanding that Sheet 13 is correct and five (5) manual valves are acceptable. If this is incorrect clarify by addendum. Additionally, please note we cannot find specifications for motor operated valves. If motor operated valves are required, provide a specification by addendum also.

A: Five manual plug valves are to be provided. The 3 "valve" symbols with an M are intended to be flow meters. One flow meter is to be installed on each blower discharge line. No motor operated valves are to be provided for the blowers.

Q: Refer to Section 03 30 00, Paragraph 3.09.B., concerning ready mix concrete temperatures. Ready mix suppliers have informed us they will have difficulty delivering concrete at 85 degrees even with the use of ice during the summer months. Specifications in this area usually allow a maximum temperature of 90 or 95 degrees F. Can a maximum temperature not to exceed 90 degrees F be acceptable for the project? Please confirm this is acceptable by addendum.

A: Changes to the hot weather concreting requirements can be discussed during construction. Retarding admixtures or other considerations may be required if allowed to exceed specified temperatures.

Q: Refer to Section 13 34 18 and Sheet 38, 39 & 40, concerning the Pole Building. We cannot locate a requirement for liner panels or insulation. It is our understanding that liner panels and insulation are not required. If this is incorrect clarify what is required by addendum.

A: Liner panels and insulation are not required at the storage building.

Q: Refer to Section 32 92 19, Paragraph 1.01.B, and Sheet 12, General Note 2, concerning restoration of slopes over 3H:1V. Section 32 92 19 specifies sod and Sheet 12 specifies erosion control matting. It is our understanding that seeding with erosion control matting is acceptable for restoration of slopes over 3H:1V. If this is incorrect clarify by addendum.

A: Provide erosion control matting per general note 2 on sheet 12.

Q: Refer to Section 26 36 23, Paragraph 2.02.B, concerning an open-top Automatic Transfer Switch. It is our understanding that an open-type transfer switch does not require an enclosure since it is provided in the MCC construction enclosure. If this is incorrect clarify by addendum.

A: This is correct.

Q: Specification section 03 30 00 calls for a maximum of 20' construction joints in slabs. The Influent Screenings Station is 31' long, do we need to break this into 2 pours? The Aeration Tanks are 35' wide, do we have to break the slab in half besides 4 pours in the other direction? The UV structure is 39' long, do we need to break this into 2 pours?

A: Base slabs may be poured with a continuous pour, provide wall joints as shown on the drawings and shown on the specifications.

Q: There is no specification on the Class X concrete fill that is called out on note 5 on sheet 19. Please provide more information on the requirements for this concrete mix.

A: Class X concrete is specified in specification section 03 30 00.

Q: Section 03 30 00, Paragraph 2.03.C & 2.03.F, concerning sodium sulfate soundness and color-metric testing. It is our understanding that the testing will not be required by the engineer. If this is incorrect clarify by addendum.

A: Assume it to be included in the cost of bid.

Q: Spec 04 20 00 part 2.02 Decorative Concrete Masonry A 4, clarify if the color choice is from the standard colors or the full range to include white?

A: Colors shall be selected by Owner.

Q: Spec 07 62 00 part 2.01 Materials A. masonry wall flashing, within the masonry related section, there is no call out for 304 ss drip edge in 3" width or termination bar. Confirm these are required as standard flexible flashing applications or is the base drip edge being omitted due to safety?

A: Provide flashing at doors, windows, etc. as described in section 07 62 00 2.01 A.

Q: Spec 04 20 00 does not list any cavity mortar net, confirm this is required as a standard cavity drainage detail.

A: Cavity mortar net is required.

Q: Sheet 45 99-ASM6.01 A Lintel detail, the description brick angle support system, confirm if the intent/required system is to be the Fero Fast and or similar (TIBS) Thermal Insulation Bracket System at the bond beam head locations. The indication of Stainless steel threaded rod adhesive anchor spacing by brick manufacturer will need to be engineered. Spec 05 50 00 does not call out any special support system for the veneer angles.

A: This question is addressed in Addendum 1.

Q: Spec 07 21 12 part 2.01 Cavity wall insulation A. polyisocyanurate foam board. Within the current market DOW Corporation has required the purchase a full Semi Trailer with all orders. This job will require 2 bunks for the masonry resulting in the required purchase of 22 additional bunks (10,560 sqft) to be able to get this product to the jobsite. Dow Corporation is also experiencing challenges with access to the raw materials. Will an alternative board insulation be spec'd that is readily available with consideration to today's market without adding significant cost to the project. Dupont cavity mate in 3" will achieve a R value of 15 and is readily available from suppliers not requiring a full semi order.

A: The specifications allow for equal product substitutions for board insulation. Product substitutions will not be reviewed until preconstruction/construction.

Q: Sheet 23 30-ASM2.01 from elevation 952.46-953.10 confirm that this is a smooth CMU to match the top course at the Eave and Gable ends, the material symbol varies from the other smooth veneer CMU.

A: Correct. The block course from 952.46-953.10 is smooth face block and will match the smooth face block at the gables.

Q: Sheet 25 30-ASM3.02 wall section, confirm the flexible flashing is to be placed behind the board insulation and terminated to the CMU back up wall with termination bar.

A: This interpretation is correct.

Q: Sheet 25 30ASM3.02 clarify at the gable detail the description of 16" lintel block, confirm if the intent is to have 2 open bottom bond beam courses with standard 8" block dimensions.

A: Intent is to have 16" bond beam. The bond beam shall be cut to match roof pitch, and minimum 8" depth shall be maintained at all locations.

Q: Sheet 25 99-ASM6.01 Detail A Jamb detail reflects returning the split faced veneer to the back up wythe, sheet 46 99-ASM6.02 Detail A jamb detail reflects no return with a bolt on angle to the CMU wall, confirm which sheet details supersede.

A: Provide bolt on angle without returned veneer block.

Q: Masonry control joints are not marked within the drawings, will the control joint locations be annotated on the prints?

A: Provide control joints as described in section 04 20 00 3.07. Engineer will review joint plan during preconstruction/construction phase.

Q: Please provide drawings of the existing structures, so we can accurately estimate the work for removing these structures.

A: See table for existing approximate top of wall elevations:

Structure	Top of Wall Elevation (ft)
Aeration Tanks	950.00 ±
Sludge Drying Beds	955.25 ±
Mechanical Clarifier	949.00 ±
Upflow Clarifiers	949.00 ±
Sludge Holding Tank	950.00 ±
Dosing Tank	946.80 ±
Surface Sand Filters	948.10 ±
Chlorine Contact Tank	943.95 ±

**BIDDERS MUST ACKNOWLEDGE RECEIPT OF THIS ADDENDUM IN THE
SPACE PROVIDED IN THE BID FORM**

Dated at Cincinnati, Ohio
April 8, 2022

STRAND ASSOCIATES, INC.®
615 Elsinore Place, Suite 320
Cincinnati, OH 45202



Matthew Smith
4/8/2022



Meeting Register
 Sycamore Trails WWTP Upgrades
 Warren County Board of Commissioners
 March 24, 2022 10 A.M.

Please verify your contact information. If it is correct, please check the box (☐) to the left. If updates are necessary, or if you have not previously provided this information, please print your information in the spaces provided.

	Name/Representing	Mailing Address	Contact Information
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<input type="checkbox"/>	Brad Delebar Advanced Solution and Controls		Phone No.: 937-520-9380 Cell No.: 937 901 7175 Fax No.: E-mail: BDelebar@AS-controls.com



Meeting Register
 Sycamore Trails WWTP Upgrades
 Warren County Board of Commissioners
 March 24, 2022 10 A.M.

Please verify your contact information. If it is correct, please check the box () to the left. If updates are necessary, or if you have not previously provided this information, please print your information in the spaces provided.

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SECTION 01 11 00

SUMMARY OF WORK

PART 1–GENERAL

1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract.

1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS–INTENT AND USE

A. Intent of Documents:

1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

B. Use of Documents:

1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
2. CONTRACTOR shall use all of the Project Drawings and Specifications:
 - a. For a complete understanding of the Project.
 - b. To determine the type of construction and systems required.
 - c. For coordination with other contractors.
 - d. To determine what other work may be involved in various parts or phases.
 - e. To anticipate and notify others when work by others will be required.
 - f. And all other relevant matters related to the project.
3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONSTRUCTION REQUIREMENTS

- A. In general, the following contract completion Milestones shall be followed. See Agreement for specific dates:
1. Milestone 1 Completion: CONTRACTOR shall by that date, have completed and placed in service influent screens, aeration splitter, aeration tanks, MLSS tank, and electrical building.
 2. Milestone 2 Completion: CONTRACTOR shall by that date, have completed and placed in service final clarifiers, RAS/WAS pumping stations, drain pumping station.
 3. Substantial Completion: CONTRACTOR shall by that date, have the UV structure, post aeration tank, sludge holding tank, and final phase demolition substantially completed.
- B. General Information and Requirements:
1. Currently, wastewater treatment at the Sycamore Trails Wastewater Treatment Plant influent screening, extended aeration activated sludge biological treatment, two clarifiers operated in series, tertiary treatment with sand filtration, chlorine tablet disinfection, and post aeration. Waste activated sludge is collected from two sets of clarifiers. The mechanical clarifiers and upflow clarifiers. There are two phases of clarification at this plant which run in a series. In order, the influent is clarified first by the mechanical clarifier, and then the upflow clarifier. Wasted sludge is stored in the sludge holding tank. The stored sludge is then removed and transported to a different wastewater treatment plant for treatment and disposal.
 2. Wastewater treatment during construction must be continuous and the treatment efficiency must be equal to that achieved prior to the start of construction.
 3. It shall be the responsibility of CONTRACTOR to not in any way impair the normal treatment or operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service or that temporary facilities be provided prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, and temporary construction required to complete the Work.
 4. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
 5. CONTRACTOR is responsible for draining all existing tanks and removing tank contents, including transfer of mixed liquor from existing aeration tanks to new aeration tanks. CONTRACTOR is responsible for all removal and disposal of sludge, grit, or other residue. CONTRACTOR is responsible for any pumping necessary for the Work. If there exists sludge, grit, or other residue that cannot be drained or pumped in its present state, it shall be the responsibility of the CONTRACTOR to remove and dispose of this material. OWNER will not be responsible for tank draining or cleaning required for the Work.
 6. Access: CONTRACTOR shall maintain roadways open at all times to meet OWNER's requirements, including access for sludge hauling vehicles and chemical deliveries. CONTRACTOR shall be responsible for maintaining roadways in drivable condition, including placement of temporary stone and gravel and providing drainage as

necessary. All city-owned roadways around the treatment facility shall be cleaned of construction site materials, soil, and debris as necessary.

C. Construction Sequence:

1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining treatment of the wastewater treatment plant. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work, complete treatment processes, or place unit processes in service. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.
2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the treatment activities. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
3. CONTRACTOR shall install erosion control measures.
4. CONTRACTOR shall install its temporary utilities and facilities. The proposed location of temporary facilities shall be approved by OWNER.
5. In general, new facilities shall be completed and placed into successful operation before the existing facilities are taken out of service.
6. Prior to equipment startup, mechanical equipment shall be checked by the manufacturer and written notice provided that the equipment is ready for startup.
7. CONTRACTOR shall coordinate with OWNER prior to removing equipment from service.
8. Disinfection must be in service from May 1st to October 31st with either the existing chlorine disinfection system or the proposed ultraviolet light disinfection system.
9. All existing clarifiers (Mechanical Clarifiers and Upflow Clarifiers) and Sand Filters must remain in service at all times until new Secondary Clarifiers (Structure 40) and RAS/WAS Pump Station and Valve Vault (Structure 50) are operational.
10. Work may begin on Disinfection and Post Aeration Structure (Structure 60) at any time.
11. Milestone 1 includes the demolition of the Sludge Drying Beds and the construction of the Influent Screening Station (Structure 10), the Aeration Tanks (Structure 20), the Electrical Building (Structure 30) and backup generator. Milestone 1 includes the construction of the proposed electrical service, blowers and aeration piping, and influent piping to the proposed Structure 10. It will likely be necessary to re-lay a portion of the existing influent sewer to the existing aeration tanks to accommodate the construction of Structure 20. CONTRACTOR shall be responsible for installing this pipe in a manner that allows continuous influent flow at the existing capacity to the existing aeration tanks during the Milestone 1 Construction. CONTRACTOR shall maintain OWNER's ability to continue the existing treatment processes during the construction of Milestone 1 components. Piping is to be installed at MH-1 to connect to new influent screening structure. Temporary bypass pumping may be required and is to be provided by CONTRACTOR. See specification Section 33 01 31–Sewer Bypass Pumping.
12. During construction and replacement of the existing utility transformer, CONTRACTOR shall provide a temporary generator to power the entire WWTP. The generator shall be 80kW, 100kVA, 240 volts, three phase. CONTRACTOR shall be responsible for fuel and

monitoring of the temporary generator at all times. The generator shall be tied into the existing 200-amp manual transfer switch at the Blower Building. Generator shall be utilized until temporary power to the entire WWTP can be provided from new MCC-30 in the new Electrical Building or commencement of demolition of the existing Blower Building.

13. Following the construction of Milestone 1 components, CONTRACTOR shall provide a temporary 45-kVA, 480-120/240-volt, three-phase, 4-wire transformer and a temporary 225-amp, 120/240-volt, three phase, 4-wire power panel. CONTRACTOR shall provide a temporary 70-amp, 3-pole circuit breaker in an existing space in MCC-30 for power to the temporary transformer and power panel. Provide all temporary cabling and conduit as required. The power panel shall include the feeder circuit breakers noted below. Provide all temporary cabling and conduit to the following loads as, required. If this temporary power panel is used to power the entire WWTP, a 100-amp, 3-pole breaker shall also be provided in the power panel for this temporary feed.
 - a. 60-amp, 3-pole (Mechanical Clarifier Control Panel).
 - b. 30-amp, 3-pole (Uplift Clarifier Control Panel).
 - c. 20-amp, 3-pole (Surface and Sand Filter Control Panel).
 - d. 20-amp, 3-pole (Chlorine Contact Tank Control Panel).
14. The Utility Company has indicated that they will not provide any type of temporary electrical service for construction purposes and that they will not allow the existing electrical service and the new electrical service to be energized at the same time. CONTRACTOR will be required to provide all temporary power required for their construction services.
15. Plumbing system in Structure 30 (toilets, sinks, etc.) will not be operational until the completion of Milestone 2 because the Plant Drain Pumping Station is needed to take waste from the facility. Potable water connection to Structure 30 shall remain shutoff until the Plant Drain Pumping Station and Valve Vault (Structure 80) is in service.
16. New influent screens must be in service before new aeration tanks are put in service. New aeration tanks may not be operated unless new influent screens are operational.
17. It is likely that OWNER will operate one or two of the three proposed aeration tanks for forward flow biological treatment. New aeration tanks may be used as equalization basins or as a sludge holding tank. OWNER will be responsible for these operations during construction.
18. New aeration tanks will be connected to the existing Mechanical Clarifiers to allow operation during construction of proposed Secondary Clarifiers (Structure 40). CONTRACTOR shall provide temporary piping from each side of the mixed liquor splitter section of the Aeration Tanks (Structure 20) to the individual existing Mechanical Clarifiers. Temporary piping shall be four-inch-diameter minimum and will require being buried. CONTRACTOR shall temporarily provide a total of four submersible pumps to be installed in the hopper sections on the west side of the mechanical clarifiers to pump return activated sludge to the newly constructed Aeration Tank. Each pump shall have a capacity of approximately 25 gallons/minute. CONTRACTOR is responsible for providing temporary power as necessary from OWNER's electrical system. Pumps shall be submersible sewage ejector types capable of handling return sludge with solids concentrations of up to 10,000 mg/L. OWNER may waste sludge by hauling mixed liquor directly out of the aeration basins and taking for offsite disposal or may use an unused Aeration Tank for sludge storage. OWNER may elect to use an unused aeration tank for flow equalization. If this occurs, OWNER will be responsible for installing temporary pumping and piping necessary to accommodate this. Existing Upflow Clarifiers (downstream of existing Mechanical Clarifiers) shall remain in service. Return sludge discharge shall be rerouted to the influent of the Mechanical Clarifiers by CONTRACTOR.

19. Milestone 2 involves the demolition of the Aeration Tanks, Sludge Holding Tank, Blower Building and the construction of the Secondary Clarifiers (Structure 40), RAS Pumping Station (Structure 50), and Plant Drain Pumping Station (Structure 80). CONTRACTOR must provide OWNER 4 week notice before demolition is to begin on Sludge Holding Tank. Demolition of the existing Aeration Structure and Sludge Holding Tank may not begin until the new Influent Screening Station (Structure 10), Aeration Tank (Structure 20) and Electrical Building (Structure 30) are substantially complete and fully operational.
20. A temporary connection to the outfall may be necessary once the Disinfection and Post Aeration Structure (Structure 60) is completed and ready to be placed in service and before the Surface Sand Filters and Chlorine Contact Tank are demolished. Any temporary piping shall have a capacity of 1.08 mgd and shall be provided by CONTRACTOR. Smaller temporary pipe may be used if CONTRACTOR provides detailed schedule for installation of permanent pipe and if said schedule is approved by OWNER.
21. Demolition of Mechanical Clarifier, Upflow Clarifiers, Surface Sand Filters may not begin until the Secondary Clarifiers (Structure 40), RAS Pumping Station (Structure 50), Disinfection, and Plant Drain Pumping Station (Structure 80) are substantially complete and in service.
22. Construction of Sludge Storage Tank (Structure 70) and Storage Building (Structure 90) may begin after demolition of Mechanical Clarifier, Upflow Clarifiers, Surface Sand Filters and Chlorine Contact Tank is complete.
23. Demolition of the Chlorine Contact Tank may not begin until the Disinfection and Post Aeration Structure (Structure 60) is substantially complete and in service.

1.05 CONTRACTOR USE OF SITE

A. General:

1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
2. Construction activities shall be confined within the "area of the site" limits.
3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER as shown on the Drawings.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER at locations shown on the Drawings.
4. Trees may not be cleared for parking, deliveries, or any other activities unless specified by OWNER. Construction limits shall be clearly marked and areas of the construction limits shall not be disturbed.

- 1.06 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES
- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
 - B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
 - C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
 - D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.
 - E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
 - F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
 - G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
 - H. Existing Underground Utilities may consist of gas lines, water lines, storm sewers, and buried telephone and electric cables. The utilities shown on the drawings are based on data furnished by the utility companies.
 - I. CONTRACTOR shall notify the Ohio Utilities Protection Service (OUPS), (811 or 1-800-362-2764), and any other non-OUPS/non-OGPUPS utility a minimum 48 hours prior to commencing work on the project to coordinate the marking of utilities in the field.
 - J. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
 - K. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
 - L. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.
 - M. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The

record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.

- N. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required, the service or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- O. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.
- P. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing services and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional Work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

1.07 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.

1.08 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for use of other lands during construction. Copies of such agreements shall be provided to OWNER.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the drawings or specified herein.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.
- B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules and regulations.
- C. Obtain and pay for all necessary permits, licenses and certificates required.

1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction sequence included in Division 01 of these specifications and in accordance with the construction phases of this project and work to be done by other contractors.

PART 2–PRODUCTS

2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 33 30 10–Buried Piping and Appurtenances and Section 40 05 00–Piping and Appurtenances.

PART 3-EXECUTION

3.01 BREAKING DOWN AND REMOVING STRUCTURES

- A. General:
 - 1. All existing structures, with all attached parts and connections, shown on the drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
 - 2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
 - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
 - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.
 - 3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.
- B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:
 - 1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
 - 2. Sufficient removal shall be made to provide for proper grades and connections in the new work.
- C. Walls, Piers, Surface Drains, Foundations, and Similar Masonry Structures:
 - 1. Remove entirely or break down to an elevation at least 2 feet below the earth subgrade within the areas of a road bed and elsewhere to 2 feet below the finished slopes or natural ground, as the case may be.
 - 2. Remove existing construction as required to clear new construction.
- D. Underground Tanks (Other than Septic Tanks):
 - 1. Remove the contents of underground tanks to allow the complete removal of such tanks.
 - 2. Backfill the resulting hole or pit in accordance with the backfill portion of this section.
- E. Pipe Culverts:
 - 1. Remove entirely all culverts that are to be removed, except as hereinafter provided for closing culverts.
 - 2. Remove sidewalls or substructure units in water to an elevation no higher than the elevation of the natural stream or lake bed.
 - a. Where grading of the channel is required, remove such units to the proposed finished grade of the stream or lake bed.
 - b. Remove all other endwalls or substructure units down to at least 2 feet below natural or finished ground line, as the case may be.
 - 3. Where existing culverts are to be extended or otherwise incorporated into the new work, remove only such part or parts of the existing culvert as necessary to provide a proper connection to the new work.
 - 4. Remove pipe culverts designated for salvage in a manner that will preclude damage to the culverts.
 - 5. Closing culverts:
 - a. A culvert may be closed instead of being removed if the following conditions apply:

- (1) If the diameter of the culvert is less than 48 inches.
 - (2) If the top thereof does not come within 5 feet of the elevation of the finished grade line.
 - (3) If the culvert is in suitable condition.
- b. Remove the headwall and such parts as would be within 2 feet of the finished grade line.
 - c. Completely fill each end of the culvert with concrete for a distance from each end of at least 2 feet plus the height of the opening of the structure.

3.02 ABANDONING STRUCTURES

- A. Tanks, Manholes, Catch Basins, and Inlets:
 1. CONTRACTOR shall thoroughly clean structures to be abandoned.
 2. CONTRACTOR shall plug existing pipe connections with brick or concrete block masonry or with any grade of concrete having a 28-day compressive strength in excess of 2,000 psi.
 3. CONTRACTOR shall remove the walls of the structures to an elevation at least 2 feet below the finished grade line, or to such elevation that may be designated on the drawings or as necessary to clear new construction.

3.03 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.
- C. CONTRACTOR shall remove or abandon the following utilities and process piping systems. The following list is not intended to be all-inclusive.
 1. Sludge piping.
 2. Air piping.
 3. Non-potable water piping.
 4. Forward flow piping.
 5. Sanitary piping.
 6. Effluent piping.
 7. Potable water piping.
 8. Secondary effluent piping.
 9. Drain piping.
 10. Primary influent piping.

3.04 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with motor

control center, control panel, or their junction with conduit serving other equipment that is to remain.

- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated. Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.
- D. CONTRACTOR shall remove equipment bases, anchor bolts, and other supports serving equipment to be removed. Concrete bases shall be removed to 1 inch below floor elevation and repaired with nonshrink grout plus surfacing to match existing.
- E. CONTRACTOR shall patch floors, walls, and ceilings as required to match existing or as indicated where equipment, piping, electrical, bases, or supports are removed.
- F. CONTRACTOR shall remove the following major equipment items or systems. The following list is not intended to be all-inclusive. CONTRACTOR shall remove all items indicated or specified to be removed.
 - 1. Manual bar screen.
 - 2. Sludge pumps and controls.
 - 3. Aeration tank air diffusers.
 - 4. Sludge tank air diffusers.
 - 5. Upflow clarifier mechanisms.
 - 6. Mechanical clarifier mechanisms.
 - 7. Aeration tank blowers and controls.
 - 8. Sludge tank blowers and controls.
 - 9. Dosing tank pumps and controls.
 - 10. Post aeration diffusers.
 - 11. Chlorinator and dechlorinator equipment.
 - 12. Samplers and other equipment in blower building.

3.05 INTERIOR PIPING, DUCTWORK, AND APPURTENANCES

- A. CONTRACTOR shall remove all piping, ductwork, and appurtenances as indicated. The location and elevations of existing piping are approximate.
- B. CONTRACTOR shall remove all supports for piping, ductwork, and appurtenances indicated to be removed. Repiping and connections to new piping shall be as specified for new piping. Remaining piping and tubing, not reconnected for new piping, shall be fitted with an appropriate blind flange or plugged and insulated as required.
- C. CONTRACTOR shall patch all holes resulting from removal of piping, ductwork, appurtenances, and their supports. Patching of concrete shall be with nonshrink grout and as indicated. Patching of masonry shall be with matching material toothed in. Patch other material as indicated.

3.06 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.

- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.
- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.

3.07 BACKFILL

- A. CONTRACTOR shall fill all abandoned structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 31 23 00—Excavation, Fill, Backfill, and Grading for required degree of compaction.
- B. Prior to filling, CONTRACTOR shall break one opening in the floor or wall near the base of each compartment to allow groundwater to freely migrate through the structure.

END OF SECTION

SECTION 07 31 13

ASPHALT SHINGLE ROOFING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes granular-surfaced asphalt shingle roofing, including shingles, underlayment, eave protection membrane, shingle-over ridge vents, sheet flashing, drip edging, and related accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM D226–Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- B. ASTM D3018–Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules.
- C. ASTM D3462–Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
- D. ASTM D4586–Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- E. UL 580–Tests for Wind Uplift Resistance of Roof Assemblies.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the provisions of Section 01 33 00–Submittals.
- B. Submit two copies of shingle warranty for review.
- C. Submit shingle color samples for selection by OWNER.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply felts or shingles in cold weather. Storage of bundles in heated area several days prior to use can permit shingling where unheated shingles would crack.

1.05 WARRANTY–SHINGLES

- A. Provide 30-year material warranty covering cost to replace defective shingles, exclusive of labor, in the event of manufacturing defect(s) in the shingles. In addition, provide a 5-year material/labor warranty covering cost to repair or replace defective shingles, including cost of roof tear-off and excluding costs of flashing and metal work, up to the full replacement cost of the shingles.

- B. Material warranty shall be equal to the Certainteed Corporation 30-year limited warranty. Material and labor warranty shall be equal to the Certainteed Corporation 5-year Sure Start Protection warranty.

PART 2-PRODUCTS

2.01 ASPHALT SHINGLES

- A. Asphalt shingles shall be 12 inches by 36 inches two-piece laminated, 245 pounds per square, self-sealing, UL Class A, wind-resistant, fiberglass shingles surfaced with mineral granules, and conforming to ASTM D3018 and ASTM D3462.
- B. Acceptable products include the following, or equal:
 - 1. Certainteed Landmark Shingle.
 - 2. GAF Materials Corporation. Timberline Prestique High Definition 30.
- C. Color shall be as selected by OWNER.

2.02 UNDERLAYMENT AND EAVE PROTECTION MEMBRANE

- A. Underlayment for all areas, except along eaves, shall be No. 15 unperforated asphalt saturated felt conforming to ASTM D226.
- B. Eave (ice dam) protection shall be a sheet membrane of rubberized asphalt bonded to sheet polyethylene, 40 mils minimum total thickness, with strippable release paper. Acceptable products include the following, or equal:
 - 1. Ice and Water Shield by W.R. Grace Company.
 - 2. Winter Guard Waterproofing Shingle Underlayment by Certainteed Corporation.

2.03 ACCESSORIES

- A. Nails shall be annular-barbed or ring-barbed galvanized roofing nails with minimum 3/8-inch-diameter head and sufficient length to penetrate through the plywood sheathing.
- B. Plastic cement shall be asphalt type with mineral fiber components conforming to ASTM D4856. It shall be free of asbestos and toxic solvents and shall be capable of setting within 24 hours at temperatures of 75°F and 50% RH.
- C. Lap cement shall be fibrated cutback asphalt type recommended for use in underlayment and shall be free of asbestos and toxic solvents.
- D. Continuous shingle-over ridge vents shall be constructed of plastic and shall be formed with vent openings that do not permit direct water or weather entry or insect/bird entry. Vents shall provide minimum 12.2 square inches of net-free ventilation per linear foot. Acceptable products include the following:
 - 1. Ridge Master by Mid-America Building Products Corporation.
 - 2. Series 4 or Series 5 by North American Building Products, Inc. Manufacturer shall provide 40-year limited material warranty on product.

2.04 FLASHING

- A. Sheet flashing shall be minimum 0.03-inch-thick aluminum, mill finish, conforming to ASTM B209.
- B. Exposed edges of flanges shall be hemmed a minimum 1/4 inch on the underside. Underside shall be coated with acid and alkali-resistant bituminous paint.
- C. Drip cap edging shall be aluminum style "D".
- D. Provide aluminum pipe boots for roof pipe penetrations.

PART 3–EXECUTION

3.01 EXAMINATION

- A. CONTRACTOR shall examine all roof decks on which roofing is to be applied and shall notify ENGINEER in writing prior to starting work of any defects which CONTRACTOR may consider detrimental to the proper installation of their materials. Roof deck shall be smooth, dry, free from dirt and foreign material before starting roofing.
- B. Verify that roofing penetrations are in place and properly flashed and that roof openings are correctly formed.

3.02 INSTALLATION–EAVE (ICE DAM) PROTECTION

- A. Place eave edge and gable edge metal flashings tight with fascia boards. Weather lap joints 2 inches and seal with plastic cement. Secure flange with galvanized nails spaced 8 inches o.c.
- B. Apply eave protection membrane in accordance with manufacturer's instructions. Extend eave protection membrane minimum 4 feet upslope beyond interior face of exterior wall.

3.03 INSTALLATION–PROTECTIVE UNDERLAYMENT

- A. Place one ply of underlayment over areas not protected by eave protection. Install underlayment perpendicular to slope of roof. Underlayment shall be weather-lapped a minimum 4 inches over eave protection membrane, and weather-lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place.
- B. If the roof slope is 4 in 12 or flatter, place a second ply of underlayment over first layer with ends and edges weather-lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place.
- C. Weather-lap and seal water-tight with plastic cement items projecting through or mounted on roof.

3.04 INSTALLATION–VALLEY PROTECTION

- A. Place one layer of sheet metal flashings, minimum 24 inches wide, centered over open valleys and crimped to guide water. Weather-lap joints minimum 2 inches. Nail in place minimum 8 inches o.c. and 1 inch from edges.

3.05 INSTALLATION–METAL FLASHING AND ACCESSORIES

- A. Weather-lap joints minimum 2 inches and seal weather-tight with plastic cement.
- B. Secure in place with nails at 8 inches o.c. Conceal fastenings.
- C. Flash and seal work weather-tight projecting through or mounted on roofing with plastic cement.

3.06 INSTALLATION–ASPHALT SHINGLES

- A. Place shingles in straight coursing pattern with 4-inch weather exposure on slopes of 4-in-12 or flatter and 5-inch weather exposure on slopes 5-in-12 and steeper.
- B. Project first course of shingles 3/4 inch beyond fascia boards.
- C. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
- D. Cap hips and ridges with individual shingles maintaining 5-inch weather exposure. Place to avoid exposed nails.
- E. Coordinate installation of roof-mounted components of work projecting through roof with weather-tight placement of counter flashings.
- F. Complete installation to provide weathertight service.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCE

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes providing all chain link fencing and gates complete, as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A121–Zinc-Coated (Galvanized) Steel Barbed Wire.
- B. ASTM A392–Zinc-Coated Steel Chain-Link Fence Fabric.
- C. ASTM A428–Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- D. ASTM A491–Aluminum-Coated Steel Chain Link Fence Fabric.
- E. ASTM A1011–Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- F. ASTM A121–Metallic Coated Steel Barbed Wire.
- G. ASTM F626–Fence Fittings.
- H. ASTM F567–Installation of Chain-Link Fence.
- I. ASTM F900–Industrial and Commercial Swing Gates.
- J. ASTM F1043–Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- K. Chain Link Fence Manufacturers’ Institute (CLFMI)–Product Manual.

PART 2–PRODUCTS

2.01 POSTS, RAILS, AND BRACES

- A. Construction:
 - 1. All posts and rails shall be either tubular pipe conforming to ASTM F1043 Group 1A, Schedule 40 with a Type A zinc coating, or Group 1C cold-formed and welded pipe with a Type B zinc coating.

2. Post sizes shall be in accordance with the following:

LINE POSTS (MAXIMUM 10 FEET SPACING)

Height and Fence Type	Post Type	O.D. (IN.)	Weight (PLF)
Up to 8 feet	Group 1A	2.375	3.65

CORNER AND BRACE POSTS

Height and Fence Type	Post Type	O.D. (IN.)	Weight (PLF)
8 feet or 10 feet without wind screen, hardware cloth or privacy inserts	Group 1A	2.875	5.79

3. Gate posts shall conform to manufacturer's specifications for various width gates. Minimum sizes shall be as follows:

GATE POSTS

Leaf Width	Post Type	O.D. (IN.)	Weight (PLF)
6 feet or less	Group 1A	2.875	5.79
7 feet to 13 feet	Group 1A	4.0	9.10
14 feet to 18 feet	Group 1A	6.625	18.97

4. Terminal posts shall be braced with the same material as top rail and trussed to line posts with 3/8-inch-diameter rods and tightened. One brace assembly shall be provided with each end or gate post and two assemblies with each corner or pull post.
5. Rails shall be 1 5/8 inch OD Group 1A 2.27 pound per foot or Group 1C 1.84 pounds per foot pipe.

B. Line Posts: Line posts may not be driven posts.

C. Required Arms, Rails, and Tension Wires: Provide rampart arm, top rail, intermediate rail, and bottom tension wire

2.02 FABRIC

A. Construction:

1. Fabric to be No. 9 gauge steel aluminum-coated steel wire woven in a 2-inch mesh; top selvage to have barbed finish, bottom selvage to be knuckled.
2. Fabric height shall be as noted on the drawings.

2.03 GATES

A. General:

1. Provide additional horizontal and vertical members as necessary to provide proper gate operation and attachment to fabric and hardware.
2. Provide diagonal braces made of crossed adjustable length 3/8-inch-diameter truss rods on nonwelded gate frames and on welded frames where corner rigidity is not sufficient to prevent sag.

3. Gate frames shall be covered with the same fabric as the fence.
4. Weld or assemble gate frames with malleable or pressed steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges. Attach to frame at 15 inches o.c. all sides. Provide caps for all gate frame work ends.

B. Gate Hardware:

1. Provide heavy-duty hinges of malleable iron, pressed or forged steel, nonlift-off type, adjusted to permit 180-degree gate opening. Provide two hinges for each leaf.
2. Provide heavy-duty forked-type or plunger bar-type latches for all single-leaf gates. Provide center stop and keeper for all double-leaf gates. Provide spring latch for all sliding gates. Provide padlock eye as an integral part of all latches.
3. Provide heavy-duty track, ball bearing hanger sheaves framing and supports, guides, stays stops, and bracing necessary for sliding gates.

2.04 ACCESSORIES

- A. General: All accessories, except tie wires and barbed wire, shall be galvanized to comply with ASTM F626.

B. Barbed Wire:

1. Provide three strands of barbed wire at top of fence.
2. Barbed wire shall be 2-strand, 12 1/2 gauge wire with 14 gauge, 4-point round barbs spaced approximately 5-inch o.c.
3. Finish shall be galvanized to meet ASTM A 121, Class 3 or aluminized to meet ASTM A 585, Class 2.

C. Barbed Wire Supporting Arms:

1. Arms shall be heavy pressed steel complete with provisions for anchorage to tubular end, corner, and pull posts attaching three rows of barbed wire to each arm.
2. Arms not required on roll formed terminal posts.
3. Single arms shall be integral with a post top weather cap.
4. Intermediate arms shall have hole for passage of top rail.
5. Arms shall be capable of withstanding, without failure, 250 pounds of downward pull at outermost end of arm.

D. Post Tops:

1. Material shall be pressed steel or malleable iron.
2. Top shall be weathertight.
3. Top shall permit passage of top rail.

E. Stretcher Bars:

1. Stretcher bars required for tubular end, corner, pull, or gate posts.
2. Bars shall be one-piece lengths equal to full height of fabric with minimum cross section of 3/16 inch by 3/4 inch.
3. Provide one stretcher bar for each gate and end post and two stretcher bars for each corner and pull post.

F. Stretcher Bar Bands:

1. Material shall be heavy pressed steel.
2. Spacing shall be 15 inches maximum o.c. to secure stretcher bar to tubular end, corner, pull, and gate post.

- G. Tension Wire: 7 gauge zinc-coated steel wire.
- H. Ground Rods: Provide a 1/2-inch-diameter 6-foot-long copper clad rod to provide a ground. Provide one for each 1,000 feet of fence and one for each separated fence section.

2.05 CONCRETE

- A. Concrete shall be Type A or A-FA, as specified in Section 03 30 00–Cast-In-Place Concrete.

PART 3–EXECUTION

3.01 SITE WORK

- A. Prior to fence construction, remove and dispose of all trees, brush, logs, stumps, and other debris for a width of at least 12 inches each side of the proposed fence alignment.

3.02 CONCRETE FOOTINGS

- A. Excavate holes for footings to neat dimensions in firm ground so that the post will be centered. Remove rock or other obstructions encountered to the required depth. Use forms in unstable soil, and allow them to remain in place for at least 24 hours after concrete is poured. Backfill, after forms are removed, with suitable material thoroughly compacted in place in layers to prevent settlement.
- B. Footings shall be 3 feet deep and 10 inches minimum diameter. The bottom of the post shall be 3 inches above the bottom of the hole. Corner, gate, and end post bases shall be 12 inches minimum diameter. Gate posts larger than 4 inches o.d. shall have a base with a minimum diameter of 18 inches. Concrete bases shall be domed at the post and have a smooth troweled finish. Concrete footings shall cure for seven days before placing tension wires.

3.03 POSTS AND BRACES

- A. Set posts in a vertical position at the required location and alignment. Set tops at the required elevation to provide a smooth profile at the top rail or tension wire without abrupt changes and in conformity with the general contour.
- B. Place an end post at each end of each run of fence. Place a corner post whenever a break of 30 degrees or more occurs in the horizontal alignment. Set an intersection post in line with an intersecting chain link fence and brace it to the adjacent posts of the intersecting fence.
- C. Place an intermediate-braced post where the vertical alignment changes by more than 5 degrees, or a change in fence grade of more than 9% occurs.
- D. Place an intermediate braced post at 660-foot intervals for fence with a top rail and at 1,000-foot intervals for fence with a top tension wire on all long runs of fence. Set an intermediate brace post at the approximate midpoint when runs of fence are less than 1,320 feet but more than 660 feet for fence with top rail, or less than 2,000 feet but more than 1,000 feet for fence with top tension wire.
- E. Where driven posts are specified, all end, corner, gate, and brace posts must be set in concrete. Driven posts shall be driven a minimum of 32 inches into undisturbed soil.

3.04 POST BRACING ASSEMBLY

- A. Post bracing assemblies consist of one or more brace rails and a 3/8-inch truss rod as hereafter specified. Provide brace rails the same size as the top rail. Provide truss rods with an adjustable take-up adapter.
- B. Install a single bracing assembly at each gate and end post location.
- C. Install a double bracing assembly at each corner post and all intermediate braced posts.
- D. Provide the bracing assembly with one horizontal brace rail and one diagonal truss rod on all fences which have a top rail. Locate the horizontal brace rail in accordance with the manufacturer's specifications.
- E. Provide the bracing assembly with one horizontal brace rail and one diagonal brace rail and one diagonal truss rod on all fences which do not have a top rail. Locate the horizontal rail in accordance with the manufacturer's specifications.

3.05 STRETCHER BARS

- A. Provide one stretcher bar for each gate and end post and two for each corner and pull post, except roll form posts with integral loops. Attach to posts with heavy-duty pressed steel or malleable iron bands spaced at 15 inches o.c.

3.06 GROUND RODS

- A. Connect at least three fence wires to the ground rod by clamping, bolting, or brazing. Ground rod shall be installed on line with fence.
- B. Where required, install ground rods as specified for each run of fence, and install additional rods for each 1,000 feet on long runs of fence.

3.07 FABRIC

- A. Install, stretch, and anchor tension wires to each end, corner, gate, and brace post and properly attach to each line post before the fabric is placed. Pass top tension wire (when required) through the post top rail opening. Install top and intermediate rails at proper locations.
- B. Hang fabric on the inside secure side of all installations.
- C. Attach the end of the fabric to the end, corner, gate, or brace posts (except roll form posts with integral loops) by means of a stretcher bar threaded through the end loops of the fabric and stretched to remove all slack with proper stretching equipment. Secure the stretched fabric to posts, rails, and tension wires with specified fabric fasteners. Install fabric fasteners on all posts at not greater than 14 inches o.c. and on rails and bottom tension wires at not more than 24 inches o.c. Where a top tension wire is installed, fasten to the fabric at not more than 18 inches o.c.
- D. Repeat stretching operations at approximately every 100 feet for each run of fence.
- E. Make splices in fabric by interweaving a wire picket through each end loop of each piece of fabric. Each splice shall be subject to ENGINEER's review.

3.08 GRADE CLEARANCE

- A. For line and property fences, provide a clearance of 3 inches.
- B. For security fence installations, install the fence with 5 inches clearance.
- C. For gates wider than 4 feet, provide a clearance of 5 inches.

3.09 GATES

- A. Install gates plumb and level and adjust for smooth operation as intended without binding or hanging up.

3.10 BARBED WIRE

- A. Install barbed wire properly fastened to the rampart arms.

3.11 CLEANUP

- A. After chain link fence construction is completed, clean up all storage and work areas. Replace or repair, as required, all landscape features damaged or disturbed under this Contract.

END OF SECTION

Sycamore Trails Wastewater Treatment Plant Upgrades Project
Warren County Water and Sewer Department

PLAN HOLDERS LIST

Sycamore Trails Wastewater Treatment Plant Upgrades Project

Individuals or companies can be added to the plan holders list by contacting Krystal Powell at krystal.powell@co.warren.oh.us

Name	Company	Phone Number	E-mail Address
Tiffany Gibson	Kirk Bros. Co., Inc.	419-595-4003	t.gibson@kirkbros.com
Eric Yerian	Howell Contractors, Inc.	937-907-1230 Ext. 205	eyerian@howellcontractors.com
Darrenn Pegg	ICS Electrical Services	513-662-2600	dpegg@icselectricalservices.com
Wayne Jankovich	Electrical Process Solutions, LLC	513-266-3367	wjankovich@eps-industrial.com
Ted Wagner	Dugan and Meyers	502-894-4481	twagner@dugan-meyers.com
Terry Lawhon	Phoenix Service Group	513-667-7846	tjlawhon@outlook.com

PLAN HOLDER: _____

Set No.: _____

PROJECT MANUAL
SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
CONTRACT 1-2021
WARREN COUNTY BOARD OF COMMISSIONERS
WARREN COUNTY, OHIO



Matthew Smith 2/17/2022



Shane P. Zenz 2/17/2022



David Dale Rice 2/11/2022

Prepared by:

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Cincinnati, OH 45202
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Issued for Bid
February 24, 2022



SECTION 00 01 10

TABLE OF CONTENTS

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
CONTRACT 1-2021
WARREN COUNTY BOARD OF COMMISSIONERS
WARREN COUNTY, OHIO

Pages
Through

DIVISION 00–BIDDING AND CONTRACTING REQUIREMENTS

INVITATION TO BIDS	00 10 10- 1
BID PROPOSAL	00 10 20- 3
BID FORM	00 10 30- 1
BID EQUIPMENT AND COMPONENTS	00 10 40- 2
EXCEPTION SHEET	00 10 50- 1
GENERAL INSTRUCTIONS TO BIDDERS	00 20 00- 8
NONCOLLUSION AFFIDAVIT – FORM 1	00 30 10- 1
NONCOLLUSION AFFIDAVIT – FORM 2	00 30 20- 1
AFFIDAVIT OF NON-DELINQUENCY OF REAL AND/OR PERSONAL PROPERTY TAX	00 30 30- 1
FINDINGS FOR RECOVERY AFFIDAVIT	00 30 40- 1
EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS, BID CONDITIONS, NON-DISCRIMINATION, AND EQUAL EMPLOYMENT OPPORTUNITY AFFIDAVIT	00 30 50- 4
BONDING REQUIREMENTS	00 40 00- 1
BID GUARANTY AND CONTRACT BOND	00 40 10- 2
PERFORMANCE BOND	00 40 20- 2
EXPERIENCE STATEMENT	00 50 10- 5
CONTRACT	00 60 10- 3
WAGE RATE DETERMINATION	00 70 10- 1
PERMITS	00 70 20- 1
SUPPLEMENTAL CONDITIONS	00 71 00-12
GENERAL CONDITIONS	00 72 00-43

SPECIFICATIONS

DIVISION 01–GENERAL REQUIREMENTS

SUMMARY OF WORK	01 11 00- 7
CONTRACT CONSIDERATIONS	01 29 00- 2
COORDINATION, FIELD ENGINEERING, AND MEETINGS	01 31 00- 3
SUBMITTALS	01 33 00-11
REGULATORY REQUIREMENTS	01 41 00- 2
REFERENCE STANDARDS AND DEFINITIONS	01 42 00- 6
QUALITY CONTROL	01 45 00- 2
TEMPORARY FACILITIES	01 50 00- 3
FIELD OFFICES AND SHEDS	01 52 13- 3
TEMPORARY CONTROLS	01 57 00- 2
MATERIALS AND EQUIPMENT	01 60 00- 4

CUTTING, PATCHING, AND ALTERATIONS	01 73 29- 5
CONTRACT CLOSEOUT	01 77 00- 3
STARTING OF SYSTEMS.....	01 91 00- 8
 <u>DIVISION 03-CONCRETE</u>	
CONCRETE FORMWORK	03 11 00- 4
CONCRETE REINFORCEMENT	03 20 00- 5
CAST-IN-PLACE CONCRETE	03 30 00-16
 <u>DIVISION 04-MASONRY</u>	
MORTAR AND MASONRY GROUT	04 05 13- 3
UNIT MASONRY SYSTEM.....	04 20 00- 7
 <u>DIVISION 05-METALS</u>	
METAL FABRICATIONS	05 50 00- 8
HANDRAILS AND RAILINGS	05 52 00- 2
GRATING	05 53 00- 3
ANCHOR BOLTS AND POST-INSTALLED ANCHORS	05 56 00- 3
 <u>DIVISION 06-WOOD, PLASTICS, AND COMPOSITES</u>	
WOOD FRAMING AND SHEATHING.....	06 11 00- 3
PLATE CONNECTED WOOD TRUSSES.....	06 17 53- 4
LAUNDRY COVER SYSTEM	06 60 12- 4
FIBERGLASS WEIRS AND BAFFLES	06 61 14- 4
 <u>DIVISION 07-THERMAL AND MOISTURE PROTECTION</u>	
BOARD INSULATION.....	07 21 12- 2
BATT AND BLOWN-IN INSULATION	07 21 13- 2
VAPOR AND AIR BARRIER	07 26 00- 1
SHEET METAL ROOFING	07 61 00- 4
FLASHING AND SHEET METAL.....	07 62 00- 3
MANUFACTURED ROOF SPECIALTIES.....	07 71 00- 2
GUTTERS AND DOWNSPOUTS	07 71 23- 2
CAULKING AND SEALANTS	07 90 00- 3
 <u>DIVISION 08-OPENINGS</u>	
STANDARD STEEL DOORS AND FRAMES.....	08 11 00- 3
ACCESS DOORS AND FRAMES.....	08 31 13- 3
DOOR HARDWARE	08 71 00- 3
GLAZING.....	08 81 00- 2
 <u>DIVISION 09-FINISHES</u>	
GYPSON BOARD	09 29 00- 4
PAINTING.....	09 91 00-10

DIVISION 10–SPECIALTIES

PLASTIC AND METAL SIGNS	10 14 00- 3
TOILET AND BATH ACCESSORIES.....	10 28 00- 3
FIRST AID KIT.....	10 43 16- 1
FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES.....	10 44 43- 2

DIVISION 11–EQUIPMENT

LABORATORY FURNITURE AND EQUIPMENT	11 53 00- 7
--	-------------

DIVISION 13–SPECIAL CONSTRUCTION

POLE BUILDINGS.....	13 34 18- 5
---------------------	-------------

DIVISION 20–COMMON, PLUMBING, AND HVAC REQUIREMENTS

IDENTIFICATION FOR PLUMBING, AND HVAC PIPING AND EQUIPMENT	20 05 53- 4
--	-------------

DIVISION 22–PLUMBING

GENERAL PLUMBING PIPING SPECIALTIES	22 05 19- 4
GENERAL DUTY VALVES FOR PLUMBING PIPING	22 05 23- 2
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.....	22 05 29- 5
PIPING INSULATION FOR PLUMBING	22 07 19- 6
FACILITY WATER DISTRIBUTION PIPING	22 11 00- 7
SANITARY WASTE AND VENT PIPING	22 13 16- 5
SANITARY WASTE PIPING SPECIALTIES	22 13 19- 4
SUBMERSIBLE PUMPS.....	22 13 29- 4
PLUMBING EQUIPMENT.....	22 30 00- 2
COMMERCIAL PLUMBING FIXTURES.....	22 42 00- 3

DIVISION 23–HEATING, VENTILATING, AND AIR CONDITIONING

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	23 05 29- 5
TESTING, ADJUSTING, AND BALANCING	23 05 93- 3
PIPING INSULATION FOR HVAC.....	23 07 19- 4
REFRIGERANT PIPING.....	23 23 00- 5
DUCTWORK	23 31 00- 4
AIR DUCT ACCESSORIES.....	23 33 00- 2
HVAC POWER VENTILATORS.....	23 34 23- 4
SPLIT-SYSTEM AIR CONDITIONERS AND HEAT PUMPS.....	23 81 26- 6
UNIT HEATERS	23 82 39- 3

DIVISION 26–ELECTRICAL

GENERAL ELECTRICAL REQUIREMENTS	26 05 00- 9
WIRE.....	26 05 19- 9
INSTRUMENT AND COMMUNICATION WIRE AND CABLE	26 05 23- 4
SECONDARY GROUNDING	26 05 26- 4
SUPPORTING DEVICES	26 05 29- 2
CONDUIT	26 05 33- 8

BOXES	26 05 35- 4
HANDHOLES	26 05 44- 2
ELECTRICAL IDENTIFICATION	26 05 53- 5
CONTROLS AND INSTRUMENTATION	26 09 00-36
CONTROLS AND INSTRUMENTATION DRAWINGS	26 09 10- 3
SCADA SYSTEM I/O LISTING	26 09 90- 6
ELECTRICAL SERVICE SYSTEM.....	26 21 00- 2
MOTOR CONTROL.....	26 24 19-13
WIRING DEVICES.....	26 27 26- 3
OVERCURRENT PROTECTIVE DEVICES	26 28 00- 2
DISCONNECT SWITCHES	26 28 16- 2
STANDBY POWER SYSTEM.....	26 32 13-13
AUTOMATIC TRANSFER SWITCHES.....	26 36 23- 4
SURGE PROTECTIVE DEVICES (SPD)	26 43 13- 3
LIGHTING.....	26 51 13- 6
SPARE PARTS.....	26 95 10- 2

DIVISION 31–EARTHWORK

CLEARING AND GRUBBING	31 10 00- 1
EXCAVATION, FILL, BACKFILL, AND GRADING	31 23 00-14
DEWATERING	31 23 19- 3
SLOPE PROTECTION AND EROSION CONTROL	31 25 00- 6
GEOTEXTILES.....	31 32 19- 1
RIPRAP	31 37 00- 2

DIVISION 32–EXTERIOR IMPROVEMENTS

AGGREGATE BASE COURSE	32 11 23- 2
FLEXIBLE PAVEMENT	32 11 26- 4
CONCRETE CURB AND GUTTER, SIDEWALKS, DRIVEWAYS, AND DRIVEWAY APRONS	32 16 13- 5
PRECAST MODULAR BLOCK RETAINING WALL	32 32 16-18
RESTORATION.....	32 92 00- 3
SEEDING AND SODDING	32 92 19- 5
STONE MULCH.....	32 94 00- 2

DIVISION 33–UTILITIES

BURIED PIPING AND APPURTENANCES	33 00 10-16
SEWER BYPASS PUMPING.....	33 01 31- 5
BURIED PIPING INSULATION.....	33 07 19- 4

DIVISION 40–PROCESS INTERCONNECTIONS

PIPING AND ACCESSORIES	40 05 00-16
IDENTIFICATION FOR PROCESS INTERCONNECTIONS PIPING AND EQUIPMENT	40 05 53- 5
SLIDE GATES	40 05 59.23- 4
HEAT TRACE	40 41 00- 5
MECHANICAL INSULATION	40 42 13- 5
CONTROLS AND INSTRUMENTATION EQUIPMENT	40 70 00-16

DIVISION 41–MATERIAL PROCESSING AND HANDLING EQUIPMENT

DAVIT CRANES 41 22 23- 2

DIVISION 43–PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

TRI-LOBE POSITIVE DISPLACEMENT BLOWERS..... 43 11 33- 8
SUBMERSIBLE PUMPS..... 43 25 10- 8

DIVISION 46–WATER AND WASTEWATER EQUIPMENT

SAMPLERS 46 09 00- 3
MECHANICAL FINE SCREEN 46 21 13-12
SECONDARY CLARIFIER COLLECTORS..... 46 43 21- 9
COARSE BUBBLE MIXING ASSEMBLIES..... 46 51 21- 5
MEMBRANE DIFFUSERS..... 46 51 46- 8
ULTRAVIOLET DISINFECTION SYSTEM..... 46 66 56- 7

APPENDICES (NOT PART OF CONTRACT DOCUMENTS)

WWTP UPGRADE GEOTECHNICAL REPORT -19
WWTP ELECTRICAL BUILDING AND POND GEOTECHNICAL REPORT..... -14

END OF SECTION

CONTRACT DOCUMENTS

**SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
PROJECT**

WARREN COUNTY WATER & SEWER
DEPARTMENT

WARREN COUNTY BOARD OF COMMISSIONERS
406 JUSTICE DRIVE
LEBANON, OHIO 45036
(513) 695-1250

SECTION 00 10 10
INVITATION TO BIDDERS

Separate sealed bids for the Sycamore Trails Wastewater Treatment Plant Upgrades Project will be received by the Warren County Board of Commissioners at the Office of the Warren County Commissioners, 406 Justice Drive, Lebanon, Ohio 45036, until 11:00 AM April 14, 2022 and then at said time publicly opened and read aloud.

Bid documents, including terms, general conditions, supplemental conditions, drawings and specifications are available online at the Warren County's Website at <https://www.co.warren.oh.us/Commissioners/Bids/Default.aspx>. Questions regarding the technical specifications should be directed to Kathryn Gilbert at the Warren County Water and Sewer Department, (513) 695-1645.

The project includes new mechanical screening, aeration tanks and blowers, secondary clarification, UV disinfection and post-aeration, liquid sludge storage and blower, two pumping stations, electrical building, backup generator, storage shed and corresponding electrical, control, piping, and site upgrades to be installed at the existing facility site. The estimated contract value is \$5,933,000. A non-mandatory pre-bid meeting will be held at the Warren County Administration Building, Room 128, 406 Justice Drive, Lebanon, Ohio 45036 on March 24, 2022 at 10:00 AM.

A bid guaranty, as required by Ohio Revised Code, Section 153.54, shall accompany each proposal submitted, as follows:

1. A Certified check, cashier's check, or letter of credit equal to ten (10) percent of the bid. A letter of credit may only be revocable by the Owner. Upon entering into a contract with the Owner, the contractor must file a performance bond for the amount of the contract, and the bid guaranty will then be returned to the successful and unsuccessful bidders upon contract execution.

OR

2. A form of bid guaranty bond (attached) for the full amount of the bid. Such bond is retained for the successful bidder, but returned to unsuccessful bidders after the contract is executed.

Warren County reserves the right to reject any or all bids submitted, to waive any irregularities in bids, and enter into a contract with the Bidder who in Warren County's consideration offered the lowest and best bid. By order of the Board of County Commissioner, County of Warren, State of Ohio.

Tina Osborne, Clerk

SECTION 00 10 20
BID PROPOSAL

The undersigned declares that the only persons or parties in this Bid are as stated; that the Bid is made without any collusion with other persons, firms, or corporations; that all the Contract Documents as prepared have been carefully examined; that the undersigned is fully informed in regard to all conditions pertaining to the Work and the place where it is to be done, and from them the undersigned makes this Bid. The undersigned do hereby propose to furnish all labor, materials, tools, equipment, etc., necessary to complete the work at the Sycamore Trails Wastewater Treatment Plant and that the bid include all costs including, permit fees, taxes, insurance, overhead, and profit. All material and equipment must comply with the specifications and contract drawings that comprise the Contract Documents.

The premiums for all Bonds required shall be paid by the Contractor and shall be included in the Contract Price. The undersigned Bidder further agrees that the Bid Security accompanying this Bid shall become the property of the County if the Bidder fails to execute the Agreement.

If any addenda are published on Warren County's website at <https://www.co.warren.oh.us/Commissioners/Bids/Default.aspx>, pursuant to SECTION 00 20 00, Paragraph 7, the undersigned acknowledges receipt of the following Addenda:

No. _____, dated _____, 2022

No. _____, dated _____, 2022

No. _____, dated _____, 2022

The price Bid shall include the following:

Item 1 - Wastewater Treatment Plant Improvements, Complete. The lump sum Bid for this item shall include furnishing all materials, labor, tools, and equipment necessary to perform all general, mechanical, electrical, plumbing, demolition, excavation, dewatering, backfilling, stormwater management, paving, and site work to complete the improvements, complete and ready for operation in accordance with the Contract Documents.

The lump sum Bid for this item shall include complete installation of all equipment, including Base Bid items indicated on the Bid Equipment and Components schedule (Section 00 10 40) listed hereinafter; equipment testing; equipment start-up to date of final acceptance; and temporary facilities required during construction. The successful BIDDER will be required to furnish a breakdown of this lump sum Bid item as required for estimating purposes. Payment will be made in accordance with the General Conditions.

The undersigned hereby certifies under the penalty of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person or entity. The bid proposals shall remain in full force and effect for sixty (60) days after the date of opening bids. The full name and address of all persons and parties interested in the foregoing bids as principals are as follows:

Individual, Partnership, or Corporation

Signature of Corporate Officer, President, or Owner

Date

Notice of acceptance should be mail or delivered to the following:

COMPANY NAME: _____

CHIEF EXECUTIVE OFFICER: _____

ADDRESS: _____

PHONE NUMBER: _____

FAX NUMBER: _____

PROJECT CONTACT PERSON: _____

PHONE NUMBER: _____

E-MAIL ADDRESS: _____

FEDERAL ID #: _____

WEBSITE ADDRESS: _____

NOTE: The firm, corporate or individual name of the bidder must be signed in ink in the space provided for the signatures on the proposed blanks. In the case of a corporation, the title of the officer signing must be stated and such officer must be thereunto duly authorized and the seal of said corporation duly affixed. In the case of a partnership, the signature of at least one of the partners must follow the firm name, using the term "member of the firm." In the case of an individual, use the terms "doing business as", or "sole owner."

**SECTION 00 10 30
BID FORM**

BIDDER agrees to perform all the work described in the Contract Documents for the following prices:

Item	Description	Quantity	Unit	Amount
1	Base Bid	1	L.S.	
2	Electrical Service Allowance	1	L.S.	\$15,000.00
3	Testing Services Allowance Section 31 23 00–Excavation, Fill, Backfill, and Grading	1	L.S.	\$15,000.00
4	Furnishing Allowance (to be directed by OWNER)	1	L.S.	\$10,000.00
5	Local Wireless Access Point Equipment and Tablet	1	LS	\$6,000.00

Total of Bid Items 1 through 5 \$ _____

Total Bid Items 1 through 5 (In Words)

Bidder's Name

L.S. = Lump Sum

SECTION 00 10 40
BID EQUIPMENT AND COMPONENTS

BIDDER shall indicate by placing an "X" in the "()" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for this category of equipment or component identified by product name and specification number.

For the submersible pumps, coarse bubble mixing assemblies and ultraviolet disinfection system, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter deducts to the Bid Form sum for alternative equipment, as noted in each category below.

BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications will be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	Product Manufacturer or Supplier
Controls and Instrumentation (Section 26 09 00)	<input type="checkbox"/> a. Frakes Engineering <input type="checkbox"/> b. Integrated Process Solutions <input type="checkbox"/> c. Wunderlich-Malec <input type="checkbox"/> d. Automated Systems Engineering <input type="checkbox"/> e. BSI <input type="checkbox"/> f. Jacobs
Tri-Lobe Positive Displacement Blowers (43 11 33)	<input type="checkbox"/> a. Aerzen Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Submersible Pumps (43 25 10)	<input type="checkbox"/> a. Ebara Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Mechanical Fine Screen (46 21 13)	<input type="checkbox"/> a. Kusters <input type="checkbox"/> b. Huber Deducts (Write-in Equipment Manufacturer): <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____

Secondary Clarifier Collectors (46 43 21)	<input type="checkbox"/> a. Ovivo <input type="checkbox"/> b. WesTech <input type="checkbox"/> c. Evoqua Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Coarse Bubble Mixing Assemblies (46 51 21)	<input type="checkbox"/> a. Tideflex Technologies Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Membrane Diffusers (46 51 46)	<input type="checkbox"/> a. Sanitaire <input type="checkbox"/> b. Aquarius Technologies Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____
Ultraviolet Disinfection System (46 66 56)	<input type="checkbox"/> a. Trojan Technologies Deducts: <input type="checkbox"/> a. \$ _____ <input type="checkbox"/> b. \$ _____ <input type="checkbox"/> c. \$ _____

**SECTION 00 10 50
EXCEPTION SHEET**

Exceptions: Exceptions to any bid specification must be clearly stated on this sheet. This sheet must be submitted with each bid. If there are no exceptions, please indicate "none" below.

- 1) _____

- 2) _____

- 3) _____

- 4) _____

- 5) _____

- 6) _____

SECTION 00 20 00
GENERAL INSTRUCTIONS TO BIDDERS

1. **Receipt and Opening of Bids:** The Warren County Board of Commissioners (herein referred to as "Owner"), invites bids on the form attached hereto, all blanks of which must be appropriately filled in. Bids will be received by the Owner at the Office of the Warren County Board of Commissioners until 11:00 AM, April 14, 2022 and then at said office publicly opened and read aloud. The envelopes containing the bids must be sealed, addressed to Warren County Board of Commissioners at 406 Justice Drive, Lebanon, Ohio 45036, and shall be clearly marked as follows:

BID OPENING

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
11:00 AM APRIL 14, 2022

The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered.

2. **Description of Project:**

The project includes new mechanical screening, aeration tanks and blowers, secondary clarification, UV disinfection and post-aeration, liquid sludge storage and blower, two pumping stations, electrical building, backup generator, storage shed and corresponding electrical, control, piping, and site upgrades to be installed at the existing facility site. The estimated contract value is \$5,933,000.

3. **Construction Cost:** The Engineer's opinion of probable construction cost for the base bid work is \$5,933,000.

4. **Project Funding/Financing:** The contract shall be financed only through the Owner's reserved funds and does not receive financing through any State of Ohio or Federal funding.

5. **Time of Completion and Liquidated Damages:** The Bidder hereby agrees that the Contract Time shall commence on the date stipulated in the Notice to Proceed which will be issued by the Owner within 14 days of contract execution and to complete the work in accordance with the terms as stated in the Contract, and in accordance with the following schedule milestones:

Substantial completion: 480 days from Notice to Proceed.

Final completion: Site restoration work completed, and Contract Closeout shall be within 540 days from Notice to Proceed.

Any delays in substantial completion of the work that are within the control of the Contractor, their Subcontractor, or Supplier shall be subject to liquidated damages in the sum of \$200.00 for each consecutive calendar day that the project extends beyond the substantial completion deadline. See the General Conditions and Supplemental Conditions for the definition and requirements of substantial completion.

6. **Bid Documents:** Bid documents, including terms, general conditions, supplemental conditions, drawings, addenda, and other information are available online, free of charge, at the Warren County's Website at <https://www.co.warren.oh.us/Commissioners/Bids/Default.aspx>. No planholder list will be maintained by the Owner. All Addenda will be posted on the website and shall not be mailed to bidders.

7. **Non-Mandatory Pre-Bid Meeting:** A non-mandatory pre-bid meeting will be held at the Warren County Administration Building, Room 126, 406 Justice Drive, Lebanon, OH 45036 on March 24, 2022 at 10:00 AM. The meeting will be followed by a visit to the site.

8. **Addenda and Interpretations:** No interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally. Every request for such interpretation must be in writing to Kathryn Gilbert at Kathryn.Gilbert@co.warren.oh.us. To be given consideration all questions must be received by 4:00 pm on Thursday, April 7, 2022. All such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be posted on the Warren County Commissioners website <https://www.co.warren.oh.us/Commissioners/Bids/Default.aspx>., no later than three days prior to the date fixed for the opening of bids. Failure of any bidder to monitor the website and download any such addendum or interpretations shall not relieve such bidder from any obligation under his/her bid as submitted. All addenda so issued shall become part of the contract documents. Bidders shall be responsible for checking the website prior to submitting their bids.

9. **Required Forms:** Each bid must be submitted on the forms contained in the Contract Documents herein. All blank spaces for bid prices must be completed, in ink or typewritten, in both words and figures, and the foregoing certifications must be fully completed and executed when submitted. Each Bidder shall complete and submit the following forms with his/her bid:

Section 00 10 20	BID PROPOSAL
Section 00 10 30	BID FORM
Section 00 10 40	BID EQUIPMENT AND COMPONENTS
Section 00 10 50	EXCEPTION SHEET
Section 00 30 10	NONCOLLUSION AFFIDAVIT – FORM 1
Section 00 30 20	NONCOLLUSION AFFIDAVIT – FORM 2
Section 00 30 30	AFFIDAVIT OF NON-DELINQUENCY OF REAL AND/OR PERSONAL PROPERTY TAX
Section 00 30 40	FINDINGS FOR RECOVERY AFFIDAVIT
Section 00 30 50	EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS, BID CONDITIONS, NON-DISCRIMINATION, AND EQUAL EMPLOYMENT OPPORTUNITY AFFIDAVIT
Section 00 40 10	BID GUARANTY AND CONTRACT BOND
Section 00 50 10	EXPERIENCE STATEMENT

10. **Modification or Withdraw of Bid:** Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a bid must be executed) and delivered to the place where bids are to be submitted at any time prior to the opening of bids.

After opening, a Bidder may withdraw their bid from consideration if the price bid was substantially lower than the other bids, provided the bid was submitted in good faith and the reason for the price being substantially lower was a clerical mistake as opposed to a judgment mistake and was actually due to an unintentional omission of a substantial quantity of work, labor or material made directly in the compilation of the bid. Request to withdraw such bid must be made in writing and filed with the Owner within two business days after the opening of bids and prior to the acceptance thereof.

11. **Method of Award:** The Owner may reject all bids or may award the contract on the base bid or on the base bid combined with additions or deductible alternates, to the lowest and best bidder, as produces a net amount which is within the available funds.

To determine lowest and best bidder, the price of the bid will be given equal weight against the totality of the following factors: 1.) the bidder's information provided in the Section 00 50 10 Experience Statement which shall be used to judge responsibility, experience, skill, financial standing, feedback from references or prior clients—which may include Owner; 2.) the Section 00 10 30 Exception Sheet; 3.) availability.

If the total price received from the lowest and best bidder exceeds the amount of funds available to finance the contract, the Owner may:

- a. Reject all bids;
- b. Augment the funds available in an amount sufficient to enable award to the lowest and best bidder or bidders;
- c. Reduce the scope of work by eliminating certain items of work to produce a total bid which is within available funds;
- d. Reduce the scope of work by reducing the quantity of certain items of work to produce a total bid which is within available funds;
- e. Reduce the scope of work by a combination of adjustments as outlined in "c" and "d" above to produce a total bid which is within available funds.
- f. The Owner may reject all bids or may award the contract on the base bid or on the base bid combined with additions or deductible alternates as produces a net amount which is within the available funds.

The Owner may consider informal and may reject any bid not prepared and submitted in accordance with the provisions hereof. The Owner reserves the right to reject all bids, to waive any informalities or irregularities in the bids received, and to accept any bid which is deemed lowest and best.

12. **Qualification of Bidder:** The Owner may make such investigations as he/she deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder

fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein; conditional bids will not be accepted.

13. **Conditions of Work:** Each bidder must inform him/herself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his/her obligation to furnish all material and labor necessary to carry out the provisions of his/her contract. Insofar as possible the contractor, in carrying out the work, must employ such methods or means or will not cause any interruption of or interference with the work of any other contractor. No plea of ignorance of conditions that exist or that may hereafter exist, or of conditions or difficulties that may be encountered in the execution of the work as the result of failure to make such examination and investigation, will be accepted as an excuse for any failure or omission on the part of the Contractor to fulfill in every respect, all the requirements of the Contract, nor will the same be accepted as a basis for any claim whatsoever for extra compensation or for an extension of time.

14. **Obligation of Bidder:** Each bidder shall, and is hereby directed to inspect the entire site of the proposed work and judge for him/herself as to all the circumstances affecting the cost and progress of the work and shall assume all patent and latent risks in connection therewith. At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the plans and contract documents (including all addenda). The failure or omission of any bidder to examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect of his/her bid.

15. **Non-Collusion Affidavit:** The successful bidder will be required to submit non-collusion affidavit on the forms included in these Bid/Contract documents (SECTION 00 30 10 and 00 30 20). These affidavit shall be dated and executed as part of this bid.

16. **Real and/or Personal Property Tax Affidavit:** All bidders must complete the Real and/or Personal property tax affidavit (Section 00 30 30) and submit with your bid. This section should be fully completed whether or not you as a vendor/contractor own property in Warren County, Ohio.

17. **EEO Compliance:** Equal Employment Opportunity (EEO) compliance requirements and affidavit are contained in SECTION 00 30 50. Owner contracts that receive state or federal funding including, but not limited to, grants, loans, and debt forgiveness shall not be executed unless the Contractor possesses a current Certificate of Compliance issued by the State EEO Coordinator.

Every contract for or on behalf of the County for the construction, alteration, or repair of any public building or public work shall include an affidavit certifying the contractor complies with EEO requirements specified in Ohio Revised Code Section 153.59.

18. **Bid Security:**

A bid guaranty, as required by Ohio Revised Code, Section 153.54, shall accompany each proposal submitted, as follows:

1. A Certified check, cashier's check, or letter of credit equal to ten (10) percent of

the bid. A letter of credit may only be revocable by the Owner. Upon entering into a contract with the Owner, the contractor must file a performance bond for the amount of the contract, and the bid guaranty will then be returned to the successful and unsuccessful bidders upon contract execution.

OR

2. A form of bid guaranty and contract bond (attached) for the full amount of the bid. Such bond is retained for the successful bidder, but returned to unsuccessful bidders after the contract is executed.

Such cash, checks or bid bonds will be returned to bidders after the Owner has awarded the bid and has executed the contract, or, if no award has been made within 60 days after the date of the opening of bids, upon demand of the bidder at any time thereafter, so long as he/she has not been notified of the acceptance of his/her bid.

Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

19. **Liquidated Damages for Failure to Enter into Contract:** The successful bidder, upon his/her failure or refusal to execute and deliver the contract and bonds required within 10 working days after he/she has received the documents, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the bid security.

20. **Security for Faithful Performance:** Simultaneously with his/her delivery of the executed contract, the Contractor shall furnish a performance (surety) bond as security for faithful performance of this contract and for the payment of all persons performing labor on the project under the contract and furnishing materials in connection with the contract. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner. Please note that upon execution of the Contract if a Bid Guaranty/Contract Bond was submitted with your original bid a Performance Bond will not be required.

21. **Required Insurance:** In accordance with the specifications and the Supplemental Conditions, the Contractor, without restricting the obligations and liabilities assumed under the Contract Documents, shall at his own cost and expense purchase and maintaining in force until final acceptance of his work, the forms of insurance coverage as described in Section 00 80 10 Supplemental Conditions 1.2, C. Article 5 – Bonds and Insurance

Certificates from the insurance carrier stating the limits of liability and expiration date shall be filed with the Owner and Engineer before operations are begun. Such certificates shall not merely name the types of policy provided, but shall specifically refer to this Contract and shall name the Board of Warren County Commissioners and Engineer as additionally insured.

All policies as hereinafter required shall be so written that the Owner and Engineer will be notified of cancellation or restrictive amendment at least sixty days prior to the effective date of such cancellation or amendment.

If any part of the work is sublet, insurance of the same types and limits as required shall be provided by or on behalf of the Subcontractors to cover that part of the work they have contracted to perform including Property Damage Liability Special Hazards coverage if so required by this contract.

22. **Additional Obligations Upon Contact Award:** Upon award of the bid but prior to execution of the final agreement and notice to proceed, the Contractor shall submit all of the following documents, completed as required:

- 1) Contract
- 2) Performance Bond
- 3) Certificates of Insurance

23. **Wage Rates:** In the event that the rate of wages paid for any trade or occupant in the locality where such work is being performed are under current collective agreements or understandings between bona fide organizations of labor and employer, then the wages to be paid shall be not less than such agreed wage rates, nor less than the minimum rates compiled by the Federal Labor Standard Act. Copies of these prevailing wage rates have been included in these specifications. Every Contractor and Subcontractor who is subject to Ohio Revised Code, Chapter 4115 shall, as soon as he begins performance under his contract with the Owner, supply the Prevailing Wage Coordinator for the Owner a schedule of the dates on which he is required to pay wages to employees. He shall also deliver to the Prevailing Wage Coordinator within three weeks after each pay date, a certified copy of his payroll which shall exhibit for each employee paid any wages, name, current address, social security number, number of hours worked each day of the pay period and the total for each week, hourly rate of pay, job classification, fringe payments, and deductions from wages. The certification of each payroll shall be executed by the Contractor, Subcontractor, or duly appointed agent thereof and shall recite that the payroll is correct and complete and that the wage rate shown is not less than those required by the contract.

In case the Owner orders the Contractor to perform extra or additional work which may make it necessary for the Contractor or any Subcontractor under this contract to employ a person not herein specified, the Contractor will include in the contract change order for such extra or additional work, a minimum wage rate for such trade or occupation, and insofar as such extra or additional work is concerned, there shall be paid to each employee engaged in work of such trade or occupation, not less than the wage so included. Insofar as possible, local labor shall be employed on this work.

24. **Laws and Regulations:** The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full.

25. **Foreign Corporation and Contractors:** "Foreign Corporation" means a corporation incorporated under the laws of another state. No contract shall be entered into with a foreign corporation until the Secretary of State has certified that such corporation is authorized to do business in Ohio: and until, if the bidder so awarded the Contract is a person or partnership, it has filed with the Secretary of State a Power of Attorney designating the Secretary of State as its agent for the purpose of accepting service of summons in any action brought under Ohio Revised Code, Section 153.05 or under Sections 4123.01 to 4123.94, inclusive.

26. **Safety Standards and Accident Prevention:** With respect to all work performed under this contract, the Contractor shall:

- a. Comply with the safety standards provisions of applicable laws, building and construction codes and the "Manual of Accident Prevention in Construction" published by the Associated General Contractors of America, the requirements of the Occupational Safety and Health Act of 1970 (Public Law 91-596), and the requirements of title 29 of the code of Federal Regulations, Section 1518 as published in the "Federal Register", Volume 36, N. 75, Saturday, April 17, 1971.
- b. Exercise every precaution at all times for the prevention of accidents and the protection of persons (including employees) and property.
- c. Maintain at his/her office or other well known place at the job site, all articles necessary for giving first aid to the injured, and shall make standing arrangements for the immediate removal to a hospital or doctor's care of persons (including employees) who may be injured at the job site. In no case shall employees be permitted to work at a job site before the employer has made a standing arrangement for removal of injured persons to a hospital or a doctor's care.

27. **Permits:** Contractor shall keep a copy of all permits at the project site throughout the duration of the work. The permits required for the work, the permit holder, and the entity paying for the permit is outlined below. All obtained permits acquired to date are included in Section 00 70 20.

Permit	Agency	Permit Holder	Entity Paying for Permit
Permit to Install	Ohio EPA	Owner	Owner
Stormwater Notice of Intent	Ohio EPA	Contractor	No Cost
Commercial Building and Electrical Permit	Warren County Building Department	Owner	Owner
Zoning Permit	Clear Creek Township	Owner	Owner
Construction Trailer Permit	Clear Creek Township	Contractor	Contractor

28. **Subcontracts:** Contractor shall provide upon request of the Owner a list of all subcontractors intended to be used in performance of the work. In the event the Owner does not object, Contractor may have such work performed by a subcontractor. Contractor shall bind every subcontractor to, and every subcontractor must agree to be bound by the terms of the Agreement,

as far as applicable to the subcontractor's work particularly pertaining to Prevailing Wages and EEO requirements. Nothing contained in the Agreement shall create any contractual relationship between any subcontractor and Owner, nor create any obligations on the part of the Owner to pay or see to the payment of any sums to any subcontractor.

29. **Subletting of Contract:** The Contractor shall not sublet, sell, transfer or assign any portion of the contract without written consent of the Owner of his designated agent. When such consent is given, the Contractor will be permitted to sublet a portion thereof, but shall perform with his own organization, work amounting to no less than fifty percent of the total contract cost, except that any time designated in the contract before computing the amount of work required to be performed by the Contractor with his own organization, no subcontract, or transfer of contract, shall in any way release the Contractor of his liability under the contract and bonds.

30. **CONFIDENTIAL DOCUMENTS & INFORMATION:** Do not submit confidential documents or documents of any type that contain trade secrets. All materials submitted become public records once opened and may be copied upon request to anybody including competitive bidders.

END OF SECTION

**SECTION 00 30 10
NONCOLLUSION AFFIDAVIT – FORM 1**

State of _____

BID Identification _____

CONTRACTOR _____, being first duly sworn, deposes and says that he is _____ (sole owner, a partner, president, secretary, etc.) of _____, the party making the foregoing BID; that such BID is not made in the interest of or on behalf of any undisclosed person, partnership, company, association, organization, or corporation; that such BID is genuine and not collusive or sham; that said BIDDER has not directly or indirectly colluded, conspired, connived or agreed with any BIDDER or any one else to put in a sham BID, or that any one shall refrain from Bidding; that said BIDDER has not in any manner, directly or indirectly, sought by agreement, communication or conference with any one to fix the BID price of said BIDDER or of any other BIDDER, or to fix any overhead, profit, or cost element of such BID price, or of that of any other BIDDER, or to secure any advantage against the OWNER awarding the contract or anyone interested in the proposed contract; that all statement contained in such BID are true; and, further, that said BIDDER has not, directly or indirectly, submitted his BID price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid and will not pay any fee in connection therewith, to any corporation, partnership, company, association, organization, BID depository, or to any member or agent thereof, or to any other individual except to such person or persons who have a partnership or other financial interest with said BIDDER in his general business.

Signed:

Subscribed and sworn to before

me this ___ day of _____, 2022.

Seal of Notary

**SECTION 00 30 20
NONCOLLUSION AFFIDAVIT – FORM 2**

STATE OF _____
COUNTY OF _____

I, _____, holding the title and position of _____ at the firm _____, affirm that I am authorized to speak on behalf of the company, board directors and owners in setting the price on the contract, bid or proposal. I understand that any misstatements in the following information will be treated as fraudulent concealment of true facts on the submission of the contract, bid or proposal.

I hereby swear and depose that the following statements are true and factual to the best of my knowledge:

The contract, bid or proposal is genuine and not made on the behalf of any other person, company or client, INCLUDING ANY MEMBER OF THE WARREN COUNTY BOARD OF COMMISSIONERS.

The price of the contract, bid or proposal was determined independent of outside consultation and was not influenced by other companies, clients or contractors, INCLUDING ANY MEMBER OF THE WARREN COUNTY BOARD OF COMMISSIONERS.

No companies, clients or contractors, INCLUDING ANY MEMBER OF THE WARREN COUNTY BOARD OF COMMISSIONERS have been solicited to propose a fake contract, bid or proposal for comparative purposes.

No companies, clients or contractors, INCLUDING ANY MEMBER OF THE WARREN COUNTY BOARD OF COMMISSIONERS have been solicited to refrain from bidding or to submit any form of noncompetitive bidding.

Relative to sealed bids, the price of the bid or proposal has not been disclosed to any client, company or contractor, INCLUDING ANY MEMBER OF THE WARREN COUNTY BOARD OF COMMISSIONERS, and will not be disclosed until the formal bid/proposal opening date.

AFFIANT

Subscribed and sworn to before me this _____ day of _____ 2022.

(Notary Public),

_____ County.

My commission expires _____ 20__

SECTION 00 30 30
AFFIDAVIT OF NON-DELINQUENCY OF REAL AND/OR
PERSONAL PROPERTY TAX

THIS SECTION SHOULD BE FULLY COMPLETED WHETHER OR NOT YOU AS A VENDOR/CONTRACTOR OWN PROPERTY IN WARREN COUNTY, OHIO. MAKING A FALSE STATEMENT ON THIS AFFIDAVIT MAY BE PUNISHABLE BY A FINE AND/OR IMPRISONMENT.

STATE OF _____)

SS:

COUNTY OF _____)

_____ being duly cautioned and sworn, states as follows:

1. That he/she is _____ of
(Title)

(Name of Contracting Party)

2. That _____ is not presently charged with any
(Name of Contracting Party)

delinquent Real and/or Personal property taxes on the general tax list of Real and/or Personal property of Warren County.

-OR-

1. That _____ is charged with delinquent Real and/or
(Name of Contracting Party)

Personal property tax on the general tax list of Real and/or Personal property of Warren County. The amount of delinquent Real and/or Personal property tax due and unpaid including any due and unpaid penalty and interest is:

\$ _____

Further, affiant states not.

Affiant

Sworn to and subscribed in my presence this ____ day of _____ 2022.

Notary Public

This instrument was prepared by _____.

Note to Fiscal Office: If any Real and/or Personal property taxes are delinquent, you must send a copy of this statement to the County Treasurer within 30 days of the date it is submitted.

**SECTION 00 30 40
FINDINGS FOR RECOVERY AFFIDAVIT**

STATE OF _____

COUNTY OF _____, SS:

_____, upon being duly cautioned and sworn, hereby states the following based on personal knowledge:

- 1) That he/she is _____ (title), of _____ (name of bidder) and authorized to execute this affidavit; and,
- 2) That _____ (name of bidder) is not a person or entity against whom a finding for recovery has been issued by the Auditor of State, which finding for recovery is unresolved as defined in Ohio Revised Code [General Provisions] Section 9.24 (B); and,
- 3) That _____ (name of bidder) does not appear in the database of unresolved findings of recovery maintained by the Auditor of State pursuant to Ohio Revised Code [General Provisions] Section 9.24 (D).

Affiant

Sworn to and subscribed in my presence this _____ day of _____, 2022.

Notary Public

My Commission expires: _____

SECTION 00 30 50

EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS, BID CONDITIONS, NON-DISCRIMINATION, AND EQUAL EMPLOYMENT OPPORTUNITY AFFIDAVIT

Bidders shall submit a copy of a valid Certificate of Compliance issued by the State EEO Coordinator for Owner projects that receive state or federal funding. The source of financing and funding for this project is specified in SECTION 00 20 00 – INSTRUCTIONS TO BIDDERS. Bidders may contact the State of Ohio, Department of Administrative Services, Equal Opportunity Division for information on how to apply online for a certification using the Ohio Business Gateway.

Every contract for or on behalf of the County for the construction, alteration, or repair of any public building or public work shall include an affidavit certifying the contractor complies with EEO requirements specified in Ohio Revised Code Section 153.59. In addition to the affidavit, all bidders agree to the following State of Ohio standard conditions of contract for construction:

1. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex. Such action shall include, but is not limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

2. The contractor will in all solicitations or advertisements for employees placed by or on behalf of the prime contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex..
3. The contractor agrees to fully cooperate with the County, the State Equal Employment Opportunity Coordinator and with any other official or agency, or the State or Federal government which seeks to eliminate unlawful employment discrimination, and with all other State and Federal efforts to assure equal employment practices under its contract and the contractor shall comply promptly with all requests and directions from the County, the State Equal Opportunity Coordinator and any of the State of Ohio officials and agencies in this regard, both before and during construction.
4. Full cooperation as expressed in clause (3), above, shall include, but not be limited to, being a witness and permitting employees to be witnesses and complainants in any proceedings involving questions of unlawful employment practices, furnishing all information requested by the County and the State Equal Employment Opportunity Coordinator, and permitting access to its books, records, and accounts by the County and the State Equal Employment

Opportunity Coordinator for purposes of investigation to ascertain compliance with applicable rules, regulations and orders.

5. In the event of the contractor's noncompliance with the nondiscrimination clauses of its contract or with any of the said rules, regulations, or orders, its contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further County construction contracts.

In the event that is contract is terminated for a material breach of EEO requirements, the contractor shall become liable for any and all damages which shall accrue to the County as a result of said breach.

6. The contractor will require the inclusion of language reflecting these same six covenants within every subcontract or purchase order it executes in the performance of its contract unless exempted by rules, regulations or orders of the State Equal Employment Opportunity Coordinator so that these provisions will be binding upon each subcontractor or vendor. The contractor will take such as the County may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in any litigation with a subcontractor, vendor or other party as a result of such direction by the County, the contractor may be requested to protect the interests of the County.

The bidder hereby adopts the foregoing covenants?

Yes No

PLEASE NOTE: The bidder's failure to adopt the Bidder's EEO Covenants, will cause the bidder's proposal to be rejected as being non-responsive.

CERTIFICATE OF COMPLIANCE NON-DISCRIMINATION AND EQUAL EMPLOYMENT
OPPORTUNITY AFFIDAVIT (CONTRACTOR)

STATE OF _____)

SS:

COUNTY OF _____)

_____ being first duly sworn, deposes and

says that he/she is _____ of _____

the party who made the foregoing proposal; that such party as bidder does not and shall not discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex. If awarded the bid and contract under this proposal, said party shall take affirmative action to insure that applicants are employed and that employees are treated, during employment, without regard to their race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex.. If successful as the lowest and best bidder under the foregoing proposal, this party shall post non-discrimination notices in conspicuous places available to employees and applicants for employment setting forth the provisions of this affidavit.

Furthermore, said party agrees to abide by the assurances found in Section 153.54 of the Ohio Revised Code in the Contract Provisions with the Owner if selected as the successful bidder by the Owner.

Signature

Affiant

Company/Corporation

Address

City/State/Zip Code

Sworn to and subscribed before me this _____ day of _____, 2022.

(seal)

Notary

CERTIFICATE OF COMPLIANCE NON-DISCRIMINATION AND EQUAL EMPLOYMENT
OPPORTUNITY AFFIDAVIT (SUB CONTRACTOR)

STATE OF _____)

SS:

COUNTY OF _____)

_____ being first duly sworn, deposes and

says that he _____ of _____

the party who made the foregoing proposal; that such party as bidder does not and shall not discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex. If awarded the bid and contract under this proposal, said party shall take affirmative action to insure that applicants are employed and that employees are treated, during employment, without regard to their race, color, religion, national origin, age, disability, Vietnam era Veteran status, ancestry or sex. If successful as the lowest and best bidder under the foregoing proposal, this party shall post non-discrimination notices in conspicuous places available to employees and applicants for employment setting forth the provisions of this affidavit.

Furthermore, said party agrees to abide by the assurances found in Section 153.54 of the Ohio Revised Code in the Contract Provisions with the Owner if selected as the successful bidder by the Owner.

Signature

Affiant

Company/Corporation

Address

City/State/Zip Code

Sworn to and subscribed before me this _____ day of _____, 2022.

(seal)

Notary

SECTION 00 40 00
BONDING REQUIREMENTS

Bid guaranty, as required by Ohio Revised Code, Section 153.54, shall accompany each proposal submitted, as follows, either:

1. A Certified check, cashier's check, or letter of credit equal to ten (10) percent of the bid. A letter of credit may only be revocable by the Owner.

OR

2. A form of bid guaranty and contract bond (attached) for the full amount of the bid. Such bond is retained for the successful bidder, but returned to unsuccessful bidders after the contract is executed.

Performance bond is required upon entering into a contract with the Owner for 100 percent of the contract price when the bid guaranty is a certified check, cashier's check, or letter of credit equal to ten percent. Otherwise the bid guaranty and contract bond shall secure the performance of the contract with a penal sum of 100% of the bid. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

SECTION 00 40 10
BID GUARANTY AND CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

(Insert full name or legal title of Contractor and Address)

as Principal and

(Insert full name or legal title of Surety)

as Surety, are hereby held and firmly bound unto the Warren County Board of Commissioners hereinafter called the Obligee, in the penal sum of the dollar amount of the bid submitted by the Principal to the Obligee on _____ to undertake the project known as:

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES PROJECT

The penal sum referred to herein shall be the dollar amount of the Principal's bid to the Obligee, incorporating any additive or deductive alternate proposals made by the Principal on the date referred to above to the Obligee, which are accepted by the Obligee. In no case shall the penal sum exceed the amount of _____ DOLLARS, \$ _____. If this item is left blank, the penal sum will be the full amount of the Principal's bid, including alternates. Alternatively, if completed, the amount stated must not be less than the full amount of the bid, including alternates in dollars and cents. A percentage is not acceptable.

For the payment of the penal sum well and truly to be made we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas the above named Principal has submitted a bid on the above referred to project;

NOW, THEREFORE, if the Obligee accepts the bid of the Principal and the Principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the event the Principal pays to the Obligee the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid and such larger amount for which the Obligee may in good faith contract with the next lowest bidder to perform the work covered by the bid; or in the event the Obligee does not award the contract to the next lowest bidder and resubmits the project for bidding, the Principal will pay the Obligee the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents, required advertising, and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect.

If the Obligee accepts the bid of the Principal and within TEN days after the awarding of the contract, enters into a proper contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract is made a part of this bond the same as though set forth herein; and

IF THE SAID PRINCIPAL SHALL well and faithfully perform each and every condition of such contract; and indemnify the Obligee against all damage suffered by failure to perform such contract according to the provisions thereof and in accordance with the plans, details, specifications, and bills of material therefore; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract: we agreeing and assenting that this undertaking shall be for benefit of any materialman or laborer having a just claim, as well as for the Obligee herein; THEN THIS OBLIGATION SHALL be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

THE SAID surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of said contract or in or to the plans and specifications therefor shall in any wise affect the obligations of said surety on its bond, and it does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

SIGNED AND SEALED this _____ day of _____ 2022.

PRINCIPAL

SURETY

By: _____

By: _____
Attorney-in-fact

Title: _____

Surety Agent's Name and Address:

**SECTION 00 40 20
PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called
(Corporation, Partnership or Individual)

Principal, and _____
(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

WARREN COUNTY OHIO, BOARD OF COMMISSIONERS
406 Justice Drive
Lebanon, OH 45036

hereinafter called OWNER, in the penal sum of _____ Dollars, \$(_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the OWNER, dated the _____ day of _____, 2022, a copy of which is hereto attached and made a part hereof for the construction of:

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES PROJECT

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the guaranty period(s), and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received, hereby stipulates and agrees that

no change, extension of time, alteration or addition of the terms of the contract or the WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in counterparts, each one of which shall be deemed an original, this the _____ day of _____ 2022.

ATTEST:

(Principal)

(SEAL)

By _____

ATTEST:

(SEAL)

(Surety)

IMPORTANT: Pursuant to Ohio Revised Code §122.87(A) defines surety company as, “. . . a company that is authorized by the department of insurance to issue bonds as a surety”.

SECTION 00 50 10
EXPERIENCE STATEMENT

The Bidder is required to state in detail in the space provided below, what work they have completed of a character similar to that included in the proposed contract, to give references and such other detailed information as will enable the Owner to judge their responsibility, experience, skill and financial standing. Completion of this statement is required and must be submitted with the Bid in order to qualify for consideration for award of contract.

SUBMITTED FOR:

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT

SUBMITTED BY:

Name: _____

(Print or Type Name of Bidder)
(A Corporation/A Partnership/An Individual)
[Bidder to strike out inapplicable terms.]

Address: _____

The undersigned certifies under oath the truth and correctness of all statements and of all answers to questions made hereinafter.

(Note: Attach Separate Sheets as Required)

1.0 How many years has your organization been in business as a construction contractor?

2.0 How many years has your organization been in business under its present name?

3.0 Has any construction contracts to which you have been a party been terminated by the owner; have you ever terminated work on a construction project prior to its completion for any reason; has any surety which issued a performance bond on your behalf ever completed the work in its own name or financed such completion on your behalf; has any surety expended any monies in connection with a contract for which they furnished a bond on your behalf? If the answer to any portion of this question is "yes", please furnish details of all such occurrences including name, address, phone number, and contact person of owner, engineer, and surety, and name and date of project.

No _____ Yes _____, If yes, attach details described above.

10.0 List the states in which your organization is legally qualified to do business.

11.0 List name, address and telephone number of an individual who represents each of the following and whom OWNER may contact for a financial reference:

11.1 A surety:

Name _____

Contact _____

Address _____

_____ Phone No. _____

Financial Reference _____

11.2 A bank:

Name _____

Contact _____

Address _____

_____ Phone No. _____

Financial Reference _____

11.3 A major material supplier:

Name _____

Contact _____

Address _____

Phone No. _____

Financial Reference _____

12.0 Dated at _____ this ___ day of _____, 2022.

(Print or Type Name of Bidder)

By: _____

(Seal, if corporation)

------(Affidavit for Individual)-----

_____, being duly sworn, deposes and says that all of the foregoing qualification information is true, complete, and accurate.

------(Affidavit for Partnership)-----

_____, being duly sworn, deposes and says that he/she is a member of the partnership of _____ and that all of the foregoing qualification information is true, complete, and accurate.

------(Affidavit for Corporation)-----

_____, being duly sworn, deposes and says that he/she is _____ of _____, and that all of the (Full name of Corporation)

foregoing qualification information is true, complete, and accurate.

------(Affidavit for Joint Venture)-----

_____ and _____, being duly sworn, deposes and says that they are members of _____ (Full Name of Joint Venture)

, and that all of the foregoing qualification information is true, complete, and accurate.

------(Acknowledgment) -----

_____, being duly sworn, deposes and says that he/she is

of _____; that he/she is duly authorized to make the foregoing

(Name of Bidder)

affidavit and that he/she makes it on behalf of () himself/herself; () said partnership; () said corporation.

Sworn to before me this _____ day of _____, 2022, in the County of _____, State of _____.

(Notary Public)

My commission expires _____

(Seal)

**SECTION 00 60 10
CONTRACT**

THIS AGREEMENT, made this _____ day of _____, 2022, with the Warren County Board of Commissioners, 406 Justice Drive, Lebanon, Ohio, hereinafter called "Owner" and **CONTRACTOR NAME AND ADDRESS HERE** doing businesses as (an individual, partner, a corporation) hereinafter called "Contractor."

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the Owner, the Contractor hereby agrees with the Owner to commence and complete the construction described as follows:

SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES PROJECT

hereinafter called the project, for the sum of **\$AMOUNT AND WRITE IT OUT HERE**, and all work in connection therewith, under the terms as stated in the General Conditions and Supplemental Conditions of the Contract; and as his (its or their) own proper cost and expense furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in Contract Documents. "Contract Documents" means and includes the following:

- Addendum
- Division 00 – Contract Requirements
- Division 01 to 48 – Technical Specifications
- General Conditions
- Supplemental Conditions
- Any and All Bid Documents
- Construction Drawings

CONTRACTOR hereby agrees to commence work under this contract on or before a date to be specified in a Written "Notice to Proceed" of the OWNER and shall complete all work within the following requirements:

Substantial completion: 480 days from Notice to Proceed.

Final completion: Site restoration work completed, and Contract Closeout shall be within 540 days from Notice to Proceed.

Any delays in substantial completion of the work that are within the control of the Contractor, their Subcontractor, or Supplier shall be subject to liquidated damages in the sum of \$200.00 for each consecutive calendar day that the project extends beyond the substantial completion deadline.

This Agreement may be terminated by either party upon written notice in the event of substantial failure by the other party to perform in accordance with the terms of this Agreement. The nonperforming party shall have fifteen calendar days from the date of the termination notice to cure or to submit a plan for cure acceptable to the other party.

OWNER may terminate or suspend performance of this Agreement for OWNER'S convenience upon written notice to the CONTRACTOR. CONTRACTOR shall terminate or suspend performance of the services/work on a schedule acceptable to the OWNER.

The CONTRACTOR will indemnify and save the OWNER, their officers and employees, harmless from loss, expenses, costs, reasonable attorneys fees, litigation expenses, suits at law or in equity, causes of action, actions, damages, and obligations arising from (a) negligent, reckless or willful and wanton acts, errors or omissions by CONTRACTOR, its agents, employees, licensees, consultants, or subconsultants; (b) the failure of the CONTRACTOR, its agents, employees, licensees, consultants or subconsultants to observe the applicable standard of care in providing services pursuant to this agreement; (c) the intentional misconduct of the CONTRACTOR, its agents, employees, licensees, consultants, or subconsultants that result in injury to persons or damage to property. for which the OWNER may be held legally liable.

The CONTRACTOR does hereby agree to indemnify and hold the OWNER harmless for any and all sums for which the OWNER may be required to pay or for which the OWNER may be held responsible for failure of the CONTRACTOR or any subcontractors to pay the prevailing wage upon this project.

The OWNER agrees to pay the CONTRACTOR in the manner and at such times as set forth in the General Conditions and as amended in the Supplemental Conditions and in such amounts as required by the Contract Documents.

This Contract shall be construed under the laws of the State of Ohio, and the parties hereby stipulate to the venue for any and all claims, disputes, interpretations, litigation of any kind arising out of this Contract being exclusively in the Warren County, Ohio Court of Common Pleas (unless both parties mutually agree in writing to alternate dispute resolution), as well as waiving any right to bring or remove such matters in or to any other state or federal court.

This Agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

Contractor shall bind every subcontractor to, and every subcontractor must agree to be bound by the terms of, this Agreement, as far as applicable to the subcontractor's work particularly pertaining to Prevailing Wages and EEO requirements. Nothing contained in this Agreement shall create any contractual relationship between any subcontractor and Owner, nor create any obligations on the part of the Owner to pay or see to the payment of any sums to any subcontractor.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in two counterparts, each of which shall be deemed an original on the date first above written.

WARREN COUNTY BOARD OF COMMISSIONERS
(Owner)

David G. Young, President

ATTEST:

Tom Grossmann, Vice President

Name

Shannon Jones

(Seal)

ATTEST:

CONTRACTOR NAME HERE
(Contractor)

By: _____
Name

Title

Approved as to Form:

Assistant Prosecutor

SECTION 00 70 10
WAGE RATE DETERMINATION

Prevailing wage rates for the State of Ohio apply to this project. Contractors and Subcontractor(s) shall conform to the State of Ohio Department of Labor requirements, guidelines, and laws. Included in this section is a list of the Ohio Prevailing Wage Rates available at the time of publication. It is the responsibility of the Contractor and Subcontractor(s) to verify the wage rates prior to bidding and throughout the project. A complete list of Ohio Prevailing Wage Rates is available at the Ohio Wage and Hour website or from the Ohio Department of Commerce Wage and Hour Bureau.



Mike DeWine
Governor

Sheryl Maxfield
Director

PREVAILING WAGE GUIDE

WARREN COUNTY

OHIO DEPARTMENT OF COMMERCE

Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, PO Box 4009
Reynoldsburg, Ohio 43068-9009
Phone: 614-644-2239
Fax: 614-728-8639
www.com.ohio.gov
TTY/TDD: 1-800-750-0750

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This packet of information is provided as a summary of the Prevailing Wage guidelines and responsibilities. The Ohio Revised Code, Chapter 4115 should be referred to for the exact wording of the law. Also included are references and forms which should be helpful in the compliance of the Prevailing Wage Law.

PACKET INFORMATION INDEX

A. The Ohio Department of Commerce-Division of Industrial Compliance, Wage and Hour Administration Investigators and their assigned counties

1. The Wage and Hour Investigators for the State of Ohio are listed with their contact information.
 - a. If you have questions or need assistance pertaining to Prevailing Wage, you can contact the Investigator in your area.

B. Prevailing Wage Guide for Public Authorities

1. Notice of change of the Prevailing Wage Threshold Level.
 - a. A notification will be sent to you when there is a change of the Prevailing Wage threshold level
2. Outline of the Public Authority's responsibilities for Prevailing Wage.
3. Public Authority's Compliance Checklist form.
 - a. A form for tracking the progress of a Prevailing Wage project
4. Request form for Prevailing Wage Rates.
 - a. Prevailing Wage Rates can be obtained on the website www.com.ohio.gov
 - (1) Prevailing Wage Determination Schedule of wages must be attached to and made part of the specifications for the project, and must be printed on the bidding blanks where the work is done by contract.
5. Bid Tabulation form
 - a. A form to be completed and returned to ODOC-DIC-Bureau of Wage and Hour Administration when the contract has been awarded.
6. Prevailing Wage Bonds form
 - a. Information needed to be kept on file by the Prevailing Wage Coordinator when bonds from the Public Authority are used for a project.

C. Prevailing Wage Guidelines for the Public Authority's Coordinator

1. Guideline for the Prevailing Wage Coordinator
 - a. The Prevailing Wage complaint form and instructions can be obtained on the website www.com.ohio.gov
2. Record of the Certified Payroll Reports Received form
 - a. Helpful form for recording the Certified Payroll Reports and the dates received from the contractors and subcontractors.
3. Employee Interview form
 - a. Helpful form for the use by the Prevailing Wage Coordinator when making on-site visits.
4. Employee vs. Independent Contractor
 - a. Helpful questions when determining if a person is an Employee or an Independent Contractor.

D. Prevailing Wage Guide for Contractors

(Incorporate this section in the Specifications or supply copies for the pre-construction meeting.)

1. Outline of responsibilities for the Prevailing Wage Contractor
2. Notification form from the Contractor to the Employee
 - a. The contractor must submit to employees a completed and signed notification form.
 - b. Some Prevailing Wage Coordinators may require a copy of the completed Notification to the Employee form be submitted with the Certified Payroll Reports.
3. Certified Payroll Report form
 - a. The contractor can use any form/format he chooses as long as **ALL** the information has been provided.
4. Certified Payroll Report form instruction sheet
5. Corrected Certified Payroll Report Example
6. Affidavit of Compliance form
 - a. No Public Authority shall make final payment unless the **Final Affidavits** have been filed by the contractors and subcontractors.



Mike DeWine
Governor

Sheryl Maxfield
Director

INVESTIGATORS CONTACT INFORMATION

OHIO DEPARTMENT OF COMMERCE

Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, PO Box 4009
Reynoldsburg, Ohio 43068-9009
Phone: 614-644-2239
Fax: 614-728-8639
www.com.ohio.gov
TTY/TDD: 1-800-750-0750

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OHIO DEPARTMENT OF COMMERCE
 Division of Industrial Compliance
 Bureau of Wage and Hour Administration
 Chief, Stephen Clegg

6606 Tussing Road, PO Box 4009
 Reynoldsburg, Ohio 43068-9009
 614-644-2239
 fax: 614-728-8639
<http://www.com.ohio.gov>

INVESTIGATORS and THEIR HEADQUARTER COUNTY

<p>#48 Dave Horvath PO Box 1512 Lima, Ohio 45802-1512 Voice: (419) 302-1200 Fax: (614) 728-8639 Dave.Horvath@com.state.oh.us</p>	<p>Allen *</p>
<p>#30 Mike McKee P.O. Box 1342 Cambridge, Ohio 43725-2247 Voice/Fax: (740) 432-1987 Michael.McKee@com.state.oh.us</p>	<p>Guernsey*</p>
<p>#56 Shawn Miles P.O. Box 2547 North Canton, Ohio 44720 Voice/Fax: (614) 496-9076 Shawn.Miles@com.state.oh.us</p>	<p>Stark *</p>
<p>#37 David Rice P.O. Box 41241 Dayton, Ohio 45441 Voice: (740) 502-0883 Fax: (614) 995-7768 Dave.Rice@com.state.oh.us</p>	<p>Montgomery *</p>
<p>#35 Sean Seibert P.O. Box 422 Painesville, Ohio 44077-3938 Voice: (614) 557-8662 Fax: (614) 232-9541 Sean.Seibert@com.state.oh.us</p>	<p>Lake *</p>
<p>#11 Kela D. Thompson 6606 Tussing Rd, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-5007 Fax: (614) 232-9537 Kela.Thompson@com.state.oh.us</p>	<p>Franklin *</p>

*** Headquarter County**

<p>Stephen Clegg, Chief 6606 Tussing Road, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-8686 Fax: (614) 728-8639 Stephen.Clegg@com.state.oh.us</p>	<p>#90 Jackie Clark, Supervisor 6606 Tussing Rd, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-5019 Fax: (614) 222-2357 Jackie.Clark@com.state.oh.us</p>
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Mike DeWine
Governor

Sheryl Maxfield
Director

PREVAILING WAGE GUIDE FOR PUBLIC AUTHORITIES

OHIO DEPARTMENT OF COMMERCE

Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, PO Box 4009
Reynoldsburg, Ohio 43068-9009
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TTY/TDD: 1-800-750-0750

The Ohio Department of Commerce is an Equal Opportunity Employer and Service Provider

PREVAILING WAGE THRESHOLD LEVELS

IMPORTANT NOTICE

Before advertising for bids, contracting, or undertaking construction with its own forces, to construct a public improvement, the Public Authority shall have the Ohio Department of Commerce-Division of Industrial Compliance, Bureau of Wage and Hour Administration determine the prevailing rates of wages for workers employed on the public improvement. The wage determination must be included in the project specifications and printed on the bidding blanks where work is done by contract.

“New” construction threshold for <i>Building Construction</i>:	\$250,000
---	------------------

“Reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting” threshold level for <i>Building Construction</i>:	\$75,000
---	-----------------

As of January 1, 2022:

“New” construction that involves <i>roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction</i> threshold level has been adjusted to:	\$96,091
---	-----------------

“Reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting” that involves <i>roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction</i> threshold level has been adjusted to:	\$28,789
---	-----------------

- A) Thresholds are to be adjusted biennially by the Director of the Ohio Department of Commerce.
- B) Biennial adjustments to threshold levels are made according to the Building Cost for Skilled Labor Index published by McGraw-Hill’s Engineering News-Record, but may not increase or decrease more than 3% for any year.

If there are questions concerning this notification, please contact:

Ohio Department of Commerce
Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, PO Box 4009
Reynoldsburg, Ohio 43068-9009
Phone: 614-644-2239
Fax: 614-728-8639
www.com.ohio.gov

Public Authority Responsibilities
ORC Chapter 4115: Wages and Hours on Public Works
(Prevailing Wage Coordinator)

1. Before advertising for bids, contracting, or undertaking construction with its own forces, to construct a public improvement, the public authority shall have the Ohio Department of Commerce, Division of Industrial Compliance, Bureau of Wage and Hour Administration determine the prevailing rates of wages for workers employed on the public improvement. The wage determination must be included in the project specifications and printed on the bidding blanks where work is done by contract.
 - a) "New" construction has a threshold level of **\$250,000**.
 - b) "Reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting" has a threshold level of **\$75,000**.
 - c) "New" construction that involves roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction has a threshold level of **\$93,292**.
 - d) "Reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting" that involves roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction has a threshold of **\$27,950**.
 - i.) Thresholds are to be adjusted biennially by the Director of Ohio Department of Commerce, Division of Industrial Compliance, Bureau of Wage and Hour Administration.
 - ii.) Biennial adjustments to threshold levels are made according to the Price Deflator for Construction Index, United States Department of Commerce, Bureau of the Census, but may not increase or decrease more than 3% for any year.
2. Every contract for public work shall contain a provision that each worker employed by the contractor or subcontractor, or other person about or upon the public work, must be paid the prevailing rate of wages.
3. If contracts are not awarded or construction undertaken within ninety days (90) from the date of the determination of the prevailing wage there shall be a re-determination of the wage rates before the contract is awarded.
4. Within **seven (7) working days** after the receipt of notification of a change in the prevailing wage rates, the public authority shall notify all affected contractors and subcontractors. If it is determined that a contractor or subcontractor has violated sections 4115.03 to 4115.16 of the Ohio Revised Code because they were not notified as required, **the public authority is liable** for any back wages, fines, damages, court costs and attorney's fees for the period of time covering the receipt of wage changes, until they give the required notice.
5. No public authority shall award a contract for a public improvement to any contractor or subcontractor whose name appears on the list of debarred contractors. This list is filed with the Secretary of State by the Ohio Department of Commerce-Division of Industrial Compliance & Labor-Bureau of Wage and Hour Administration **The filing of the notice of conviction with the secretary of state constitutes notice to all public authorities**. These contractors are prohibited from working on public improvements for periods ranging from one to three years. The list of debarred contractors can be located on the website www.com.ohio.gov/laws
6. A public authority must designate and appoint **one of its own employees** to serve as the Prevailing Wage Coordinator during the life of the contract for constructing the public improvement. A Prevailing Wage Coordinator must be appointed no later than ten days before the first payment of wages by contractors to employees working on the public improvement.

PUBLIC AUTHORITY'S COMPLIANCE CHECKLIST FOR PREVAILING WAGE

Project:		Number:
Department:		Phone#:
PW Coordinator:		Phone#:
Architect/Engineer:		Phone#:
Contractor:		Phone#:
Contact Person:		Title:
General Contractor:		Prime Contractor:
		Construction Mgr:
Date Completed		Compliance Item Description
	1.	Request Prevailing Wage Determination Schedule from ODOC-DIC-Wage & Hour
	2.	Received Prevailing Wage Determination Schedule
	3.	Incorporate Determination Schedule in Specs./Bidding Blanks
	4.	Incorporate notice of Prevailing Wage requirements in Invitation for Bids/Notice to Bidders
	5.	Incorporate Prevailing Wage requirements in Contract
	6.	Submit complete Invitation for Bid to ODOC-DIC-Wage & Hour
	7.	Invitation for Bids
	8.	Bid Opening
	9.	Check Listing of Violators
	10.	Award of Contract. (see note)
	11.	Submit Bid Tabulation/Award to ODOC-DIC-WAGE & HOUR
	12.	Notice to Successful Bidder
	13.	Work Commenced...(see note)
	14.	Appoint Prevailing Wage Coordinator
	15.	Received list of Subcontractors' names, addresses, phone #'s & email's
	16.	Received Payroll Date Schedule
	17.	Received Registered Apprenticeship Agreement Certifications
	18.	Received Deduction Agreements
	19.	Received Payroll Reports with Certification...(see attachment)
	20.	Visited project site
	21.	Received Changes to Determination Schedule
	22.	Notice to Contractors of Determination Schedule change
	23.	Request Final Compliance Affidavit from contractors & subcontractors
	24.	Received Final Affidavits from all contractors & subcontractors
	25.	Certify Final Payment

Note: If contract is not awarded or construction undertaken within 90 days from the date of establishment of the Prevailing Wage Rates, a re-determination of the Prevailing Wage Rates is required.

REQUEST FOR STATE OF OHIO PREVAILING WAGE RATES

Date	(Mark (X) One) <input type="checkbox"/> ~ Residential <input type="checkbox"/> ~ Construction
------	--

Project Information (only one project and one county per request form please)

County of Project	Project Name	This form MUST be filled out COMPETELY & CORRECTLY for us to process your request. Forms not completed correctly will be RETURNED TO THE SENDER.
Site Address	City	

Owner/Public Authority	Prevailing Wage Rates can be obtained on the website www.com.ohio.gov
------------------------	---

Address	Telephone Number	ODOC-DIC-WAGE & HOUR DATE STAMP
City	Zip Code	
PW Coordinator	Telephone Number	
Issuing Authority of Bonds	Type of Financing	

Estimated Total Overall Project Cost <input type="checkbox"/> New Construction <input type="checkbox"/> "Old" Construction * A copy of this form will be returned to you with your wage rates. You must send that copy to us with your bid tabulations once the contract has been awarded.	PLEASE MAIL THIS REQUEST TO: Ohio Department of Commerce Division of Industrial Compliance Bureau of Wage & Hour Administration 6606 Tussing Road, PO Box 4009 Reynoldsburg, Ohio 43068-9009 PHONE: (614) 644-2239 FAX: (614) 728-8639
Expected Date of Contract Award	
Projected Completion Date	

Send Wage Rates to: (contractors are charged \$5.00 per county)	ODOC-DIC-W&H DATE STAMP (bid tab)
---	--

<input type="checkbox"/> Mail <input type="checkbox"/> Pick Up <input type="checkbox"/> Federal Express Account Number	
Name	Company or Public Authority
Address	

City	Zip	Telephone Number
------	-----	------------------

* "Old" construction is reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting.

INDUSTRIAL DEVELOPMENT BONDS

Bond Projects require the Public Authority to keep the following information on file			
1. Type of Bonds issued:	Amount:		
2. The total cost of the Project:			
3. The other type of financing involved in the project:			
4. Portion of the project being constructed with each type of financing:			
5. Are Prevailing Wage Rates being applied to all construction on the project: <input type="checkbox"/> Yes <input type="checkbox"/> No			
6. The name of the political subdivision who issued the bonds:			
7. When were the bonds issued:			
8. For what purpose were the bonds issued:			
9. Who handles the funds once the bonds are sold:			
10. Who is the lending institution that purchased the bonds:			
11. How are the funds to be paid out:			
12. When are the funds to be paid out:			
13. Who is the Bond Council:			
14. Who has been appointed as the Prevailing Coordinator:			
PWC Address:			
City:	OHIO	Zip:	Telephone #:
15. Obtain a copy of the inducement and other official documents for the issuance of the bonds.			



Mike DeWine
Governor

Sheryl Maxfield
Director

PREVAILING WAGE GUIDELINES
FOR THE
PUBLIC AUTHORITY'S
PW COORDINATOR

OHIO DEPARTMENT OF COMMERCE

Division of Industrial Compliance and Labor

Bureau of Wage and Hour Administration

6606 Tussing Road, PO Box 4009

Reynoldsburg, Ohio 43068-9009

Phone: 614-644-2239

Fax: 614-728-8639

www.com.ohio.gov

TTY/TDD: 1-800-750-0750

The Ohio Department of Commerce is an Equal Opportunity Employer and Service Provider

Prevailing Wage Coordinator Guidelines

For more detailed information please refer to Chapter 4115 of the Ohio Revised Code

- A. Attend any pre-bid and/or pre-construction meetings.
 - 1. To explain the prevailing wage rate requirements.
 - 2. To explain the contractor's responsibilities.
- B. Set up and maintain files containing all contractors' and subcontractors' payroll reports, affidavits, and related documents. These files must be available for public inspection.
- C. Obtain from each contractor a list of their subcontractors' names, addresses, telephone numbers, and email addresses.
- D. Require each contractor and subcontractor to provide their project dates. This will be used to make a time schedule for receiving their certified payrolls.
- E. Obtain from each contractor, the name and address of their Bonding\Surety Company.
- F. Obtain from out-of-state corporations, the name and address of their Statutory Agent. (This agent must be located in the State of Ohio and registered with the Ohio Secretary of State.)
 - 1. Records made in connection with the public improvement must not be removed from the State of Ohio for the period of one year following the completion of the project.
- G. Supply contractors with any changes in the Prevailing Wage Rates.
- H. Within two weeks after the first pay, obtain a certified payroll report from each contractor. A certified report is one that is sworn to and signed by the contractor.
 - 1. If the job will exceed four months, all reports after the initial report can be filed once per month. (The initial report must be filed within two weeks.)
 - 2. If the job will last less than four months, all reports are to be filed weekly after the initial report.
- I. Establish and follow procedures to monitor compliance by contractors and subcontractors.
 - 1. Visit project to verify posting requirements and job classifications.
 - 2. Review certified payroll reports to ensure they are submitted in a timely fashion and complete with the following information for each employee:
 - a) Name, current address, and their social security number or last 4 when permitted
 - b) Classification (must be specific for laborers and operators, including level)
 - c) Hours worked on the project
 - d) Hourly rate
 - e) Fringe benefits, if applicable
 - f) Total hours worked for the week (all jobs)
 - g) Gross wages, all deductions, net pay
 - 3. Compare rates and fringes reported to rates in prevailing wage schedule.
- J. Upon completion of the project and prior to the final payment, require an affidavit of compliance from each contractor and subcontractor. **No public authority shall make final payment to any contractor or subcontractor unless the final affidavits have been filed by the respective contractor and subcontractor. (O.R.C. section 4115.07)**
- K. Report any non-compliance to Ohio Department of Commerce, Division of Industrial Compliance, Bureau of Wage & Hour Administration. The PW complaint form and instructions can be obtained on the website www.com.ohio.gov.

RECORD OF THE CERTIFIED PAYROLL REPORTS RECEIVED

Project:		Number:
Contractor:		Phone #: Email:
General Contractor:	Prime Contractor:	Subcontractor:
Date work commenced:	Completed:	Final Affidavit:

Payroll	Payroll Date	Date Received		Payroll	Payroll Date	Date Received
1				33		
2				34		
3				35		
4				36		
5				37		
6				38		
7				39		
8				40		
9				41		
10				42		
11				43		
12				44		
13				45		
14				46		
15				47		
16				48		
17				49		
18				50		
19				51		
20				52		
21				53		
22				54		
23				55		
24				56		
25				57		
26				58		
27				59		
28				60		
29				61		
30				62		
31				63		
32				64		

PREVAILING WAGE INVESTIGATION\EMPLOYEE INTERVIEW

Failure to complete this interview form may reduce our ability to recover back wages which may be owed to you.

Project:		Case #:
Address:	City:	County:

Employee Name:		Last 4 digits of the SS#:	
Address:		City:	State: Zip:
Telephone #: (Home)	(Work)	Email:	Best time to be reached:

Another source by which we can contact you. (Someone not living at your address):

Name:	Relationship:	Telephone #:
-------	---------------	--------------

Contractor's Name:		Telephone #:
Address:	City:	State: Zip:

Date hired:	Date started on this project:	Approximate hours - Straight time:	Overtime:
-------------	-------------------------------	------------------------------------	-----------

Method of recording hours:	<input type="checkbox"/> Time Card	<input type="checkbox"/> Called into office	Recorded by:	<input type="checkbox"/> Employee	<input type="checkbox"/> Foreman
----------------------------	------------------------------------	---	--------------	-----------------------------------	----------------------------------

Did you keep a personal record of your hours worked on this project?	<input type="checkbox"/> Yes <input type="checkbox"/> No	Do you have check stubs?	<input type="checkbox"/> Yes <input type="checkbox"/> No
--	--	--------------------------	--

Did anyone else keep a personal record?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, who:
---	--	--------------

List your job classification(s):	<input type="checkbox"/> Journeyman	<input type="checkbox"/> Helper
	<input type="checkbox"/> Apprentice - Level	

List your specific job duties:	List tools\equipment used:
--------------------------------	----------------------------

Hourly rate of pay for this project:	Your regular rate of pay:
--------------------------------------	---------------------------

Fringe benefits paid by contractor:	<input type="checkbox"/> None	<input type="checkbox"/> Health Insurance	<input type="checkbox"/> Life Insurance	<input type="checkbox"/> Pension	<input type="checkbox"/> Bonus
~ Vacation - Amount _____	<input type="checkbox"/> Holidays - Amount _____	<input type="checkbox"/> Apprenticeship training	<input type="checkbox"/> Profit Sharing		
~ Other (list):					

Did you work overtime?	<input type="checkbox"/> Yes <input type="checkbox"/> No	Were hours over 40 per week paid at time and one half?	<input type="checkbox"/> Yes <input type="checkbox"/> No
------------------------	--	--	--

When is your pay day?	Method of payment:	<input type="checkbox"/> Check	<input type="checkbox"/> Cash	<input type="checkbox"/> Direct Deposit
-----------------------	--------------------	--------------------------------	-------------------------------	---

List names of co-workers on this project:

Comments:	Please provide a detailed list of the dates, times and hours worked within each classification that may apply to the work performed on a separate sheet.
-----------	--

SIGNATURE AND NOTARY	
<p>Affiant is further informed that Section 2921.13 of the Ohio Revised Code provides a penalty of a misdemeanor of the first degree and that prosecution will be pursued of those persons who "knowingly swear or affirm the truth of a false statement when ...the statement is sworn or affirmed before a notary public..."</p> <p>Sworn to before me and subscribed by the said:</p> <p>_____</p> <p>in my presence this _____ day of _____, 20____.</p> <p>_____ Notary Public</p>	<p>I hereby certify that this is a true statement to the best of my knowledge and belief.</p> <p>_____ Signature</p> <p>_____ Date</p> <p>Return to: Ohio Department of Commerce Division of Industrial Compliance & Labor Bureau of Wage and Hour Administration 6606 Tussing Road P.O. Box 4009 Reynoldsburg, Ohio 43068-9009 (614) 644-2239 www.com.ohio.gov</p>

Signature of PW Coordinator:	Date:
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EMPLOYEE VS. INDEPENDENT CONTRACTOR

EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Does the employer have the right to control and direct worker?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Does the worker receive instructions about how and where the work is to be done instead of the employer merely specifying the desired result?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Is payment based on time spent rather than a set price for the work to be performed?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Does the worker devote virtually all his working time to the employer rather than offering services to the general public?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Does the worker performing services make their services available to the general public and/or other businesses?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Is there a continuing relationship between employer and worker?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Can the worker be discharged at will?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Did the employer train the worker for the job?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR
EMPLOYEE	↔	<input checked="" type="checkbox"/> YES	Does the employer have employees performing the same work as the independent contractor?	<input type="checkbox"/> NO	↔	INDEPENDENT CONTRACTOR

EMPLOYEE VS. INDEPENDENT CONTRACTOR-continued

EMPLOYEE ↔ YES Does the worker perform services personally rather than delegating them to others? NO ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ YES Does the employer set a specific time when the individual services are to be performed? NO ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ YES Does the employer furnish the tools and materials used by the worker performing services? NO ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ YES Is the employer assuming all the financial risk, rather than the worker making a significant financial investment in the job and having the opportunity to realize a profit or loss from the work? NO ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ NO Does the individual performing the services publicly advertise these services in for example, the newspaper or yellow pages ? YES ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ NO Does the individual performing the services have a business license? YES ↔ INDEPENDENT CONTRACTOR

EMPLOYEE ↔ NO Does the individual performing the services operate d.b.a. or under a tradename? YES ↔ INDEPENDENT CONTRACTOR



Mike DeWine
Governor

Sheryl Maxfield
Director

PREVAILING WAGE GUIDE FOR CONTRACTORS

OHIO DEPARTMENT OF COMMERCE

Division of Industrial Compliance
Bureau of Wage and Hour Administration
6606 Tussing Road, PO Box 4009
Reynoldsburg, Ohio 43068-9009
Phone: 614-644-2239
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OHIO DEPARTMENT OF COMMERCE
 Division of Industrial Compliance
 Bureau of Wage and Hour Administration
 Chief, Stephen Clegg

6606 Tussing Road, PO Box 4009
 Reynoldsburg, Ohio 43068-9009
 614-644-2239
 fax: 614-728-8639
<http://www.com.ohio.gov>

INVESTIGATORS and THEIR HEADQUARTER COUNTY

<p>#48 Dave Horvath PO Box 1512 Lima, Ohio 45802-1512 Voice: (419) 302-1200 Fax: (614) 728-8639 Dave.Horvath@com.state.oh.us</p>	<p>Allen *</p>
<p>#30 Mike McKee P.O. Box 1342 Cambridge, Ohio 43725-2247 Voice/Fax: (740) 432-1987 Michael.McKee@com.state.oh.us</p>	<p>Guernsey*</p>
<p>#56 Shawn Miles P.O. Box 2547 North Canton, Ohio 44720 Voice/Fax: (614) 496-9076 Shawn.Miles@com.state.oh.us</p>	<p>Stark *</p>
<p>#37 David Rice P.O. Box 41241 Dayton, Ohio 45441 Voice/Fax: (740) 502-0883 Dave.Rice@com.state.oh.us</p>	<p>Montgomery *</p>
<p>#35 Sean Seibert P.O. Box 422 Painesville, Ohio 44077-3938 Voice: (614) 557-8662 Fax: (614) 232-9541 Sean.Seibert@com.state.oh.us</p>	<p>Lake *</p>
<p>#11 Kela D. Thompson 6606 Tussing Rd, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-5007 Fax: (614) 232-9537 kela.thompson@com.state.oh.us</p>	<p>Franklin *</p>

*** Headquarter County**

<p>Stephen Clegg, Chief 6606 Tussing Road, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-8686 Fax: (614) 728-8639 Stephen.Clegg@com.state.oh.us</p>	<p>#90 Jackie Clark, Supervisor 6606 Tussing Rd, PO Box 4009 Reynoldsburg, Ohio 43068-9009 Voice: (614) 728-5019 Fax: (614) 222-2357 Jackie.Clark@com.state.oh.us</p>
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PREVAILING WAGE CONTRACTOR RESPONSIBILITIES

This is a summary of prevailing wage contractors' responsibilities. For more detailed information please refer to Chapter 4115 of the Ohio Revised Code

General Information

Ohio's prevailing wage laws apply to all public improvements financed in whole or in part by public funds when the total overall project cost is fairly estimated to be more than \$250,000 for new construction or \$75,000 for reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting.

Ohio's prevailing wage laws apply to all public improvements financed in whole or in part by public funds when the total overall project cost is fairly estimated to be more than \$91,150 for new construction that involves roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction or \$27,309 for reconstruction, enlargement, alteration, repair, remodeling, renovation, or painting of a public improvement that involves roads, streets, alleys, sewers, ditches and other works connected to road or bridge construction.

- a) Thresholds are to be adjusted biennially by the Administrator of Ohio Department of Commerce, Division of Industrial Compliance and Labor, Bureau of Wage and Hour Administration
- b) Biennial adjustments to threshold levels are made according to the Price Deflator for Construction Index, United States Department of Commerce, Bureau of the Census*, but may not increase or decrease more than 3% for any year

Penalties for violation

Violators are to be assessed the wages owed, plus a penalty of 100% of the wages owed.

Intentional Violations

If an intentional violation is determined to have occurred, the contractor is prohibited from contracting directly or indirectly with any public authority for the construction of a public improvement. Intentional violation means "a willful, knowing, or deliberate disregard for any provision" of the prevailing wage law and includes but is not limited to the following actions:

- Intentional failure to submit payroll reports as required, or knowingly submitting false or erroneous reports.
- Intentional misclassification of employees for the purpose of reducing wages.
- Intentional misclassification of employees as independent contractors or as apprentices.
- Intentional failure to pay the prevailing wage.
- Intentional failure to comply with the allowable ratio of apprentices to skilled workers as required by the regulations established by Ohio Department of Commerce, Division of Industrial Compliance and Labor, Bureau of Wage and Hour Administration.
- Intentionally employing an officer, of a contractor or subcontractor, that is known to be prohibited from contracting, directly or indirectly, with a public authority.



Responsibilities

- A. Pay the prevailing rate of wages as shown in the wage rate schedules issued by the Ohio Department of Commerce, Division of Industrial Compliance and Labor, Bureau of Wage and Hour Administration, for the classification of work being performed.
 1. Wage rate schedules include all modifications, corrections, escalations, or reductions to wage rates issued for the project.
 2. Overtime must be paid at time and one-half the employee's base hourly rate. Fringe benefits are paid at straight time rate for all hours including overtime.
 3. Prevailing wages must be paid in full without any deduction for food, lodging, transportation, use of tools, etc.; unless, the employee has voluntarily consented to these deductions in writing. The public authority and the Director of Ohio Department of Commerce, Division of Industrial Compliance and Labor, Bureau of Wage and Hour Administration - must approve these deductions as fair and reasonable. Consent and approval must be obtained before starting the project.
- B. Use of Apprentices and Helpers cannot exceed the ratios permitted in the wage rate schedules.
 1. Apprentices must be registered with the U.S. Department of Labor Bureau of Apprenticeship and Training.
 2. Contractors must provide the Prevailing Wage Coordinator a copy of the Apprenticeship Agreement for each apprentice on the project.
- C. Keep full and accurate payroll records available for inspection by any authorized representative of the Ohio Department of Commerce, Division of Industrial Compliance, and Labor, Bureau of Wage and Hour Administration or the contracting public authority, including the Prevailing Wage Coordinator. Records should include but are not limited to:
 1. Time cards, time sheets, daily work records, etc.
 2. Payroll ledger\journals and canceled checks\check register.
 3. Fringe benefit records must include program, address, account number, & canceled checks.
 4. Records made in connection with the public improvement must not be removed from the State for one year following the completion of the project.
 5. Out-of-State Corporations must submit to the Ohio Secretary of State the full name and address of their Statutory Agent in Ohio.
- D. Prevailing Wage Rate Schedule must be posted on the job site where it is accessible to all employees.
- E. Prior to submitting the initial payroll report, supply the Prevailing Wage Coordinator with your project dates to schedule reporting of your payrolls.
- F. Supply the Prevailing Wage Coordinator a list of all subcontractors including the name, address, and telephone number for each.
 1. **Contractors are responsible for their subcontractors' compliance with requirements of Chapter 4115 of the Ohio Revised Code.**



- G. Before employees start work on the project, supply them with written notification of their job classification, prevailing wage rate, fringe benefit amounts, and the name of the Prevailing Wage Coordinator for the project. A copy of the completed signed notification should be submitted to Prevailing Wage Coordinator.
- H. Supply all subcontractors with the Prevailing Wage Rates and changes.
- I. Submit certified payrolls within two (2) weeks after the initial pay period. Payrolls must include the following information:
 - 1. Employees' names, addresses, and social security numbers.
 - a. Corporate officers/owners/partners and any salaried personnel who do physical work on the project are considered employees. All rate and reporting requirements are applicable to these individuals.
 - 2. Employees' work classification.
 - a. Be specific about the laborers and/or operators (Group)
 - b. For all apprentices, show level/year and percent of journeyman's rate
 - 3. Hours worked on the project for each employee.
 - a. The number of hours worked in each day and the total number of hours worked each week.
 - 4. Hourly rate for each employee.
 - a. The minimum rate paid must be the wage rate for the appropriate classification. The Department's Wage Rate Schedule sets this rate.
 - b. All overtime worked is to be paid at time and one-half for all hours worked more than forty (40) per week.
 - 5. Where fringes are paid into a bona fide plan instead of cash, list each benefit and amount per hour paid to program for each employee.
 - a. When the amount contributed to the fringe benefit plan and the total number of hours worked by the employee on all projects for the year are documented, the hourly amount is calculated by dividing the total contribution of the employer by the total number of hours worked by the employee.
 - b. When the amount contributed to the fringe benefit is documented but not the total hours worked, the hourly amount is calculated by **dividing the total yearly contribution by 2080**.
 - 6. Gross amount earned on all projects during the pay period.
 - 7. Total deductions from employee's wages.
 - 8. Net amount paid.
- J. The reports shall be certified by the contractor, subcontractor, or duly appointed agent stating that the payroll is correct and complete; and that the wage rates shown are not less than those required by the O.R.C. 4115.
- K. Provide a Final Affidavit to the Prevailing Wage Coordinator upon the completion of the project.

PREVAILING WAGE NOTIFICATION to EMPLOYEE

4115.05...the contractor or subcontractor shall furnish each employee **NOT covered by a collective bargaining agreement** written notification of the job classification to which the employee is assigned, the prevailing wage determined to be applicable to that classification, separated into the hourly rate of pay and the fringe payments, and the identity of the prevailing wage coordinator appointed by the public authority. The contractor or subcontractor shall furnish the same notification to each affected employee every time the job classification of the employee is changed.

Project Name:	Job Number:
Contractor:	
Project Location:	
Prevailing Wage Coordinator	Employee
Public Authority:	Name:
Name of PWC:	Street:
Street:	City:
City:	State/Zip:
State/Zip:	Phone:
	Email:
Phone:	Last 4 Digits of SS #:

You will be performing work on this project that falls under these classifications. You will be paid the appropriate rate for the type of work you are performing.

Classification:	Prevailing Wage Rate Total Package:	Minus your fringe benefits *:	Your hourly base rate and overtime:
			/
			/
			/
			/
			/
			/

Hourly fringe benefits paid on your behalf by this company (Yearly amount the **company pays** divided by 2080):

Fringe	Amount	Fringe	Amount
Health Insurance		Vacation	
Life Insurance		Holiday	
Pension		Sick Pay	
Other (Specify)		Training	
Other (Specify)		Total Hourly Fringes *	

Contractor's Signature:	Date:
Employee's Signature:	Date:

INSTRUCTIONS FOR PREPARING CERTIFIED PAYROLL REPORTS

General

Contractors and subcontractors are required by law to submit certified payroll reports for work on projects covered by Ohio's Prevailing Wage Law. This form meets the reporting requirements established by Ohio Revised Code Chapter 4115. The use of this form is not mandatory; employers may submit their own forms provided that all of the required information is included. This form may be reproduced, or additional copies obtained from:

Ohio Department of Commerce
Division of Industrial Compliance and Labor
Bureau of Wage & Hour Administration
6606 Tussing Rd, P. O. Box 4009
Reynoldsburg, OH 43068-9009
Phone: (614) 644-2239
www.com.ohio.gov

Certified Payroll Heading

Employer name and address: Company's full name and address... Indicate if the company is a subcontractor.

Subcontractor: Check and list the name of the General Contractor or Prime.

Project: Name and location of the project, including county.

Contracting Public Authority: Name and address of the contracting public authority... (Owner of the project).

Week Ending: Month, day, and year for the last day of the reporting period.

Payroll #: Indicate first, second, third, etc. payroll filed by the company for the project.

Page Indicator: number of pages included in the report.

Project Number: Determined by the public authority... if there is no number leave it blank.

Payroll Information by Column

- Employee Name, Address and Social Security number:** This information must be provided for all employees that perform physical labor on the project. Corporate officers, partners, and salaried employees are considered employees and must be paid the prevailing rate. Individual sole proprietors do not have to pay themselves prevailing rate but must report their hours on the project.
- Work Class:** List classification of work actually performed by employee. If unsure of work classification, consult the Ohio department of Commerce, Wage and Hour Bureau. Employees working more than one classification should have separate line entries for each classification. Indicate what year/level for Apprentices. Be specific when using laborer and operator classifications; for example, Backhoe Operator or Asphalt Laborer.
- Hours Worked, Day & Date:** In the first row of column 3 enter days of pay period example; M T W T H F S S. The second row is for the date that corresponds with each day for the pay period. In the employee information section enter the number of hours worked on the prevailing wage project and which day the hours were worked. Separate rows are labeled for (ST) straight time hours and (OT) overtime hours. All hours worked after 40, must be paid at the appropriate overtime rate.
- Project Total Hours:** Total the hours entered for pay period.
- Base Rate:** Enter actual rate per hour paid to the employee. The overtime hourly rate is time and one-half the base rate listed in the prevailing wage schedule plus fringe benefits at straight time rate. The prevailing wage schedule lists the base rate plus fringe benefit amounts. These amounts added together equal the total prevailing wage rate. Employers must pay this total amount in one of three ways.
 - Total rate may be paid in entirety in the base rate to the employee; in which case, the cash designation will be checked for fringe benefits.
 - Total rate may be paid as listed in prevailing wage rate schedule with total fringe amounts paid approved plans.
 - Total rate may be paid with a combination of base rate and fringe payments to approved plans in amounts other than those listed in schedule.
- Project Gross:** Enter total gross wages earned on the project for straight time and overtime. Project hours X base rate should equal project gross.
- Fringes:** If fringe benefits are paid in the hourly base rate, indicate this by marking the **Cash** space. If fringe benefits are paid to approved plans as listed in the prevailing wage rate schedule, mark the space **Approved Plans**. If fringe benefits are paid partially in the base rate and partially to approved plans, mark the space **Cash & Approved plans**. List the hourly amount paid to approved plans for each fringe. If payments are not made on a per hour basis, **calculate the hourly fringe credit by dividing the yearly employer contribution by** the lesser of: hours actually worked in the year (these must be documented) or **2080**. Fringe benefits include: **Employer's share** of health insurance, life insurance, retirement plan, bonus/profit sharing, sick pay, holiday pay, personal leave, vacation, and education/training programs. If unsure of a possible fringe benefit, contact the Ohio Department of Commerce - Division of Industrial Compliance and Labor - Bureau of Wage & Hour Administration.
- Total Hours All Jobs:** Total all hours worked during the pay period including non-prevailing wage jobs.
- Total Gross All Jobs:** Gross amount earned in the pay period for all hours worked.
- Self explanatory.
- Self explanatory.

Certified Payroll Report

Report for: Check if Subcontractor¹⁾ Contract No: _____ Payroll No: _____
 Company:¹⁾ _____ If Sub, GC/Prime Contractor Name: _____
 Address: _____ Project Name & Location: _____ Week Ending: _____
 City, State, Zip _____ Public Authority (Owner): _____
 Phone No: _____ Sheet:²⁾ _____ of _____

1. Employee Name, Address, & SS# (Last 4 digits if permitted)	2. Work Class ³⁾	3. Prevailing Wage Project Hours Worked - Day & Date							4. Total Hours	5. Base Rate	6. Project Gross	7. Fringes: <input type="checkbox"/> Cash <input type="checkbox"/> Approved Plans <input type="checkbox"/> Cash & Approved Plans						Weekly Payroll Amount			
								Fringe Rate Your Company Pays Per Hour						8. Total Hrs for all Jobs	9. Total Gross on All Jobs	10. Total Deductions	11. Net Pay on All Jobs				
		H&W	Pens	Vac	Hol	Other	Total														
	OT																				
	ST																				
	OT																				
	ST																				
	OT																				
	ST																				
	OT																				
	ST																				

1) By signing below, I certify that: (1) I pay, or supervise the payment of the employees shown above; (2) during the pay period reported on this form, all hours worked on this project have been paid at the appropriate prevailing wage rate for the class of work done; (3) the fringe benefits have been paid as indicated above; (4) no rebates or deductions have been or will be made, directly or indirectly from the total wages earned, other than permissible deductions as defined in ORC Chapter 4115; and (5) apprentices are registered with the U.S. Dept. of Labor, Bureau of Apprenticeship and Training. I understand that the willful falsification of any of the above statements may subject the Contractor or Subcontractor to civil or criminal prosecution.

Type or Print Name and Title _____ Signature _____ Date _____



Affidavit of Compliance

Prevailing Wages

I, _____ (Name of person signing affidavit) (Title)

do hereby certify that the wages paid to all employees of

_____ (Company Name)

for all hours worked on the

_____ (Project name and location)

project, during the period from _____ to _____ are in (Project Dates)

compliance with prevailing wage requirements of Chapter 4115 of the Ohio Revised Code. I further certify that no rebates or deductions have been or will be made, directly or indirectly, from any wages paid in connection with this project, other than those provided by law.

_____ (Signature of Officer or Agent)

Sworn to and subscribed in my presence this _____ day of _____, 20_____.

_____ (Notary Public)

The above affidavit must be executed and sworn to by the officer or agent of the contractor or subcontractor who supervises the payment of employees. This affidavit must be submitted to the owner (public authority) before the surety is released or final payment due under the terms of the contract is made.

Prevailing Wage Determination Cover Letter

County: WARREN
Determination Date: 02/16/2022
Expiration Date: 05/16/2022

THE FOLLOWING PAGES ARE PREVAILING RATES OF WAGES ON PUBLIC IMPROVEMENTS FAIRLY ESTIMATED TO BE MORE THAN THE AMOUNT IN O.R.C. SEC. 4115.03 (b) (1) or (2), AS APPLICABLE.

Section 4115.05 provides, in part: "Where contracts are not awarded or construction undertaken within ninety days from the date of the establishment of the prevailing wages, there shall be a redetermination of the prevailing rate of wages before the contract is awarded." The expiration date of this wage schedule is listed above for your convenience only. This wage determination is not intended as a blanket determination to be used for all projects during this period without prior approval of this Department.

Section 4115.04, Ohio Revised Code provides, in part: "Such schedule of wages shall be attached to and made a part of the specifications for the work, and shall be printed on the bidding blanks where the work is done by contract..."

The contract between the letting authority and the successful bidder shall contain a statement requiring that mechanics and laborers be paid a prevailing rate of wage as required in Section 4115.06, Ohio Revised Code.

The contractor or subcontractor is required to file with the contracting public authority upon completion of the project and prior to final payment therefore an affidavit stating that he has fully complied with Chapter 4115 of the Ohio Revised Code.

The wage rates contained in this schedule are the "Prevailing Wages" as defined by Section 4115.03, Ohio Revised Code (the basic hourly rates plus certain fringe benefits). These rates and fringes shall be a minimum to be paid under a contract regulated by Chapter 4115 of the Ohio Revised Code by contractors and subcontractors. The prevailing wage rates contained in this schedule include the effective dates and wage rates currently on file. In cases where future effective dates are not included in this schedule, modifications to the wage schedule will be furnished to the Prevailing Wage Coordinator appointed by the public authority as soon as prevailing wage rates increases are received by this office.

"There shall be posted in a prominent and accessible place on the site of work a legible statement of the Schedule of Wage Rates specified in the contract to the various classifications of laborers, workmen, and mechanics employed, said statement to remain posted during the life of such contract." Section 4115.07, Ohio Revised Code.

Apprentices will be permitted to work only under a bona fide apprenticeship program if such program exists and if such program is registered with the Ohio Apprenticeship Council.

Section 4115.071 provides that no later than ten days before the first payment of wages is due to any employee of any contractor or subcontractor working on a contract regulated by Chapter 4115, Ohio Revised Code, the contracting public authority shall appoint one of his own employees to act as the prevailing wage coordinator for said contract. The duties of the prevailing wage coordinator are outlined in Section 4115.071 of the Ohio Revised Code.

Section 4115.05 provides for an escalator in the prevailing wage rate. Each time a new rate is established, that rate is required to be paid on all ongoing public improvement projects.

A further requirement of Section 4115.05 of the Ohio Revised Code is: "On the occasion of the first pay date under a contract, the contractor shall furnish each employee not covered by a collective bargaining agreement or understanding between employers and bona fide organizations of Labor with individual written notification of the job classification to which the employee is assigned, the prevailing wage determined to be applicable to that classification, separated into the hourly rate of pay and the fringe payments, and the identity of the prevailing wage Coordinator appointed by the public authority. The contractor or subcontractor shall furnish the same notification to each affected employee every time the job classification of the employee is changed."

Work performed in connection with the installation of modular furniture may be subject to prevailing wage.

THIS PACKET IS NOT TO BE SEPARATED BUT IS TO REMAIN COMPLETE AS IT IS SUBMITTED TO YOU. (Reference guidelines and forms are included in this packet to be helpful in the compliance of the Prevailing Wage law.)

wh1500

Prevailing Wage Rate Skilled Crafts

Name of Union: Asbestos Local 8 Heat & Frost Insulators

Change # : LCN01-2021fbAsbLoc8

Craft : Asbestos Worker Effective Date : 03/10/2021 Last Posted : 03/10/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Asbestos Insulators	\$31.82		\$7.14	\$9.35	\$0.41	\$0.00	\$2.60	\$0.00	\$0.00	\$0.00	\$51.32	\$67.23
Apprentice	Percent											
1st year	46.67	\$14.85	\$7.14	\$5.10	\$0.41	\$0.00	\$2.60	\$0.00	\$0.00	\$0.00	\$30.10	\$37.53
2nd year	53.58	\$17.05	\$7.14	\$6.65	\$0.41	\$0.00	\$2.60	\$0.00	\$0.00	\$0.00	\$33.85	\$42.37
3rd year	58.30	\$18.55	\$7.14	\$6.65	\$0.41	\$0.00	\$2.60	\$0.00	\$0.00	\$0.00	\$35.35	\$44.63
4th year	63.01	\$20.05	\$7.14	\$6.65	\$0.41	\$0.00	\$2.60	\$0.00	\$0.00	\$0.00	\$36.85	\$46.87

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

- 1 Journeymen to 1 Apprentice
- 2 Journeymen to 2 Apprentice
- 3 Journeymen to 3 Apprentice
- 3 Journeymen to 1 Apprentice there After

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, BROWN, BUTLER*, CLERMONT, HAMILTON, HIGHLAND, WARREN*

Special Jurisdictional Note : In Butler County:townships of Fairfield,Hanover,Liberty,Milford,Morgan,Oxford,Ripley,Ross,St.Clair,Union & Wayne. In Warren County: Townships of Deerfield,Hamilton,Harlan,Salem,Union & Washington

Details :

All work in connection with Asbestos Removal, Abatement, Encapsulation, Lead Abatement, Hazardous Materials and Fire Stopping which is performed by employees in the Mechanic or Apprentice Classification shall be covered under the terms of this Agreement.

Prevailing Wage Rate Skilled Crafts

Name of Union: Asbestos Local 50 Zone 1

Change # : LCR01-2021sksLoc50

Craft : Asbestos Worker Effective Date : 12/17/2021 Last Posted : 12/17/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Asbestos Insulation Mechanic	\$34.36		\$7.70	\$7.85	\$0.50	\$0.00	\$2.90	\$0.05	\$0.00	\$0.00	\$53.36	\$70.54
Firestop Technician	\$34.36		\$7.70	\$7.85	\$0.50	\$0.00	\$2.90	\$0.05	\$0.00	\$0.00	\$53.36	\$70.54
Apprentice	Percent											
1st year	53.72	\$18.46	\$7.46	\$0.00	\$0.44	\$0.00	\$0.25	\$0.05	\$0.00	\$0.00	\$26.66	\$35.89
2nd year	65.09	\$22.36	\$7.70	\$0.95	\$0.44	\$0.00	\$0.50	\$0.05	\$0.00	\$0.00	\$32.00	\$43.19
3rd year	75.72	\$26.02	\$7.70	\$2.38	\$0.44	\$0.00	\$0.75	\$0.05	\$0.00	\$0.00	\$37.34	\$50.35
4th year	83.51	\$28.69	\$7.70	\$2.38	\$0.44	\$0.00	\$0.75	\$0.05	\$0.00	\$0.00	\$40.01	\$54.36

Special Calculation Note : *other is Labor Mgt Training Fund

Ratio :

1 Journeymen to 1 Apprentice
4 Journeymen to 1 Apprentice thereafter

Jurisdiction (* denotes special jurisdictional note) :

ATHENS, AUGLAIZE, BUTLER*, CLINTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HARDIN, HOCKING, KNOX, LICKING, LOGAN, MADISON, MARION, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, ROSS, SHELBY, UNION, VINTON, WARREN*

Special Jurisdictional Note : Township of Butler County-Townships of Lemon and Madison. Warren County-Township of Cleer Creek, Franklin, Massie, Turtle Creek and Wayne

Details :

Prevailing Wage Rate

Skilled Crafts

Name of Union: Asbestos Local 207 OH

Change # : LCN01-2018fbLoc207OH

Craft : Asbestos Worker Effective Date : 08/23/2018 Last Posted : 08/23/2018

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Asbestos Abatement	\$25.50	\$7.25	\$6.45	\$0.65	\$0.00	\$0.00	\$0.07	\$0.00	\$0.00	\$39.92	\$52.67
Trainee	\$16.50	\$7.25	\$1.50	\$0.65	\$0.00	\$0.00	\$0.07	\$0.00	\$0.00	\$25.97	\$34.22

Special Calculation Note :

Ratio :

3 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA*, ATHENS, AUGLAIZE, BROWN, BUTLER*, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARDIN, HARRISON, HIGHLAND, HOCKING, HOLMES, HURON, KNOX, LAKE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MIAMI, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PORTAGE, PREBLE, RICHLAND, ROSS, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN*, WAYNE

Special Jurisdictional Note : Butler County:(townships of Fairfield, Hanover, Liberty, Milford, Morgan, Oxford, Ripley, Ross, StClair, Union & Wayne.) (Lemon & Madison) Warren County: (townships of: Deerfield, Hamilton, Harlan, Salem, Union & Washington). (Clear Creek, Franklin, Mossie, Turtle Creek & Wayney). Ashtabula County: (post offices & townships of Ashtabula, Austinburg, Geneva, Harperfield, Jefferson, Plymouth & Saybrook) (townships of Andover, Cherry Valley, Colbrook, Canneaut, Denmark, Dorset, East Orwell, Hartsgrove, Kingville, Lenox, Monroe, Morgan, New Lyme, North Kingsville, Orwell, Pierpoint, Richmond Rock Creek, Rome, Sheffield, Trumbull, Wayne, Williamsfield & Windsor) Erie County: (post offices & townships of Berlin, Berlin Heights, Birmingham, Florence ,Huron, Milan, Shinrock & Vermilion)

Details :

Asbestos & lead paint abatement including, but not limited to the removal or encapsulation of asbestos & lead paint, all work in conjunction with the preparation of the removal of same & all work in conjunction with the clean up after said removal. The removal of all insulation materials, whether they contain asbestos or not, from mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) is recognized as being the exclusive work of the Asbestos Abatement Workers.

On all mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) that are going to be demolished, the removal of all insulating materials whether they contain asbestos or not shall be the exclusive work of the Laborers.

An Abatement Journeyman is anyone who has more than 300 hours in the Asbestos Abatement field.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Boilermaker Local 105

Change # : LCN02-2013fbLoc 105

Craft : Boilermaker Effective Date : 10/01/2013 Last Posted : 09/25/2013

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Boilermaker	\$35.26		\$7.07	\$13.28	\$0.89	\$0.00	\$3.00	\$0.55	\$0.00	\$0.00	\$60.05	\$77.68
Apprentice	Percent											
1st 6 months	70.03	\$24.69	\$7.07	\$11.30	\$0.89	\$0.00	\$2.10	\$0.55	\$0.00	\$0.00	\$46.60	\$58.95
2nd 6 months	75.02	\$26.45	\$7.07	\$11.30	\$0.89	\$0.00	\$2.25	\$0.55	\$0.00	\$0.00	\$48.51	\$61.74
3rd 6 months	80.00	\$28.21	\$7.07	\$11.30	\$0.89	\$0.00	\$2.40	\$0.55	\$0.00	\$0.00	\$50.42	\$64.52
4th 6 months	85.02	\$29.98	\$7.07	\$11.30	\$0.89	\$0.00	\$2.55	\$0.55	\$0.00	\$0.00	\$52.34	\$67.33
5th 6 months	87.52	\$30.86	\$7.07	\$13.28	\$0.89	\$0.00	\$2.63	\$0.55	\$0.00	\$0.00	\$55.28	\$70.71
6th 6 months	90.03	\$31.74	\$7.07	\$13.28	\$0.89	\$0.00	\$2.70	\$0.55	\$0.00	\$0.00	\$56.23	\$72.11
7th 6 months	92.50	\$32.62	\$7.07	\$13.28	\$0.89	\$0.00	\$2.78	\$0.55	\$0.00	\$0.00	\$57.19	\$73.49
8th 6 months	95.00	\$33.50	\$7.07	\$13.28	\$0.89	\$0.00	\$2.85	\$0.55	\$0.00	\$0.00	\$58.14	\$74.89

Special Calculation Note : Other is Supplemental Health and Welfare

Ratio :

5 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ATHENS, BROWN, BUTLER,
CHAMPAIGN, CLARK, CLERMONT, CLINTON,
FAIRFIELD, FAYETTE, FRANKLIN, GALLIA,
GREENE, GUERNSEY, HAMILTON, HIGHLAND,
HOCKING, JACKSON, LAWRENCE, LICKING,
MADISON, MEIGS, MIAMI, MONTGOMERY,
MORGAN, MUSKINGUM, NOBLE, PERRY,
PICKAWAY, PIKE, PREBLE, ROSS, SCIOTO,
VINTON, WARREN

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: **Boilermaker Local 154**

Change # : LCN01-2012kpLoc 154

Craft : Boilermaker Effective Date : 03/22/2012 Last Posted : 03/22/2012

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Boilermaker	\$36.17	\$8.57	\$11.28	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$62.56	\$80.65	
Trainee 60%	\$23.25	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$41.95	\$53.57	
Trainee 70%	\$27.13	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$45.83	\$59.40	
Trainee 80%	\$31.00	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$49.70	\$65.20	
Trainee 90%	\$34.88	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$53.58	\$71.02	
Apprentice Registered After 11/01/2005	Percent											
1st 6 months	60.00	\$21.70	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$40.40	\$51.25
2nd 6 months	65.00	\$23.51	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$42.21	\$53.97
3rd 6 months	70.00	\$25.32	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$44.02	\$56.68
4th 6 months	75.00	\$27.13	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$45.83	\$59.39
5th 6 months	80.00	\$28.94	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$47.64	\$62.10
6th 6 months	85.00	\$30.74	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$49.44	\$64.82
7th 6 months	90.00	\$32.55	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$51.25	\$67.53
8th 6 months	95.00	\$34.36	\$8.57	\$3.59	\$0.55	\$0.00	\$4.25	\$0.34	\$0.00	\$1.40	\$53.06	\$70.24

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

5 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BUTLER, COLUMBIANA, FAYETTE,
JEFFERSON, LAWRENCE, MERCER, WARREN,
WASHINGTON

Special Jurisdictional Note :

Details :

Work includes but not limited to: boiler making, acetylene burning, riveting, chipping, caulking, rigging, fitting-up, grinding, reaming, impact machine operating, unloading, and handling of boilermaker's material and equipment. Boilermakers, Blacksmiths, Forgers, Iron Shipbuilders

Prevailing Wage Rate Skilled Crafts

Name of Union: Bricklayer Local 18

Change # : LCN01-2021fbLoc18

Craft : Bricklayer Effective Date : 06/01/2021 Last Posted : 05/26/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Bricklayer	\$30.87		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.74	\$62.17
Stone Mason	\$30.87		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.74	\$62.17
Pointer Caulker Cleaner	\$30.87		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.74	\$62.17
Refractory Workers	\$31.87		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$47.74	\$63.67
Refractory Worker Hot Pay	\$33.87		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$49.74	\$66.67
Sawman	\$31.12		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.99	\$62.55
Layout Man	\$31.12		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.99	\$62.55
Free Standing Chimney	\$31.37		\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$47.24	\$62.92
Apprentice	Percent											
1st 6 months	60.00	\$18.52	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$34.39	\$43.65
2nd 6 months	65.00	\$20.07	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35.94	\$45.97
3rd 6 months	70.00	\$21.61	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.48	\$48.28
4th 6 months	75.00	\$23.15	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.02	\$50.60
5th 6 months	80.00	\$24.70	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$40.57	\$52.91
6th 6 months	85.00	\$26.24	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$42.11	\$55.23
7th 6 months	90.00	\$27.78	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$43.65	\$57.54
8th 6 months	95.00	\$29.33	\$9.45	\$5.79	\$0.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.20	\$59.86
MASON FINISHER 1st 180 Days	45.00	\$13.89	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$13.89	\$20.84
1st Year H&W after 6 months	45.00	\$13.89	\$9.45	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$23.34	\$30.29
2nd Year	50.00	\$15.44	\$9.45	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$24.88	\$32.60

Special Calculation Note : **In order to utilize a Pre-Apprentice, you must have 1 Registered Apprentice in your employ.

Ratio :

- 1-2 Journeyman to 1 Apprentice
- 3-4 Journeyman to 2 Apprentice
- 5-6 Journeyman to 2 Apprentice
- 7-10 Journeyman to 3 Apprentice

- 1 Apprentice permits 1 Mason Trainee
- 2 Apprentice permits 1 Mason Trainee
- 3 Apprentice permits 2 Mason Trainees
- 4 Apprentice permits 2 Mason Trainees

For each additional 5 Journeyman to 1 Apprentice,
for every 3 additional Apprentices, 1 Mason Finisher may
be added

Special Jurisdictional Note : In Preble County the following townships are included: (Dixon, Gasper, Graits, Israel, Lanier and Somers)

Details :

MASON FINISHER:duties shall be to work in all aspects of Masonry construction taking direction from the employer and the Journeyman Bricklayer & Stone Mason's working on the job. Mason Finisher's may work on job site only when a registered apprentice is on job and the ratios in table above will strictly be enforced.

Refractory work is classified as working with any of the following materials:
Acid brick, carbon black brick or carbon black block, firebrick grinding, plastics (with a gun)
and any resinous cement.

Fifty cents (\$0.50) per hour above scale shall be paid to employees working on free standing industrial or institutional chimneys which are completely detached from any building structure.

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, HAMILTON,
PREBLE*, WARREN

Prevailing Wage Rate Skilled Crafts

Name of Union: Bricklayer Local 18 Tile Finisher

Change # : LCN01-2020fbLoc18

Craft : Bricklayer Effective Date : 09/01/2020 Last Posted : 08/20/2020

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Bricklayer Tile Marble Terrazzo Finisher	\$25.74		\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.01	\$53.88
Terrazzo Base Grinder	\$26.24		\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.51	\$54.63
Marble Sander Polisher	\$25.84		\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.11	\$54.03
Apprentices	Percent											
1st 6 months 0-600 hrs	60.00	\$15.44	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$30.71	\$38.44
2nd 6 months 601-1200 hrs	65.00	\$16.73	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$32.00	\$40.37
3rd 6 months 1201-1800 hrs	70.00	\$18.02	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$33.29	\$42.30
4th 6 months 1801-2400 hrs	75.00	\$19.30	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$34.57	\$44.23
5th 6 months 2401-3000 hrs	80.00	\$20.59	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35.86	\$46.16
6th 6 months 3001-3600	90.00	\$23.17	\$9.47	\$5.29	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.44	\$50.02
1-30 Days Prior to Entering Apprenticeship	50.00	\$12.87	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$12.87	\$19.30

Special Calculation Note : Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.

Note that the classification description is clarified after the local union number at the top of the page. **In order to utilize a Pre-Apprentice, you must have 1 Registered Apprentice in your employ.**

Ratio :

- 1 Journeyman to 1 Apprentice
- 5 Journeymen to 1 Apprentice
- 10 Journeymen to 2 Apprentices
- 15 Journeymen to 3 Apprentices
- 20 Journeymen to 4 Apprentices
- 25 Journeymen to 5 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, BROWN, BUTLER, CLERMONT, GALLIA,
- HAMILTON, LAWRENCE, PREBLE*, SCIOTO,
- WARREN, WARREN*

Special Jurisdictional Note : Warren in the townships of Dixon, Gasper, Isrsel, Somers & Gratis in Prebble County

Details :

Prevailing Wage Rate

Skilled Crafts

Name of Union: Bricklayer Local 18 Tile Mechanic

Change # : LCN01-2020fbLoc18

Craft : Bricklayer Effective Date : 09/01/2020 Last Posted : 08/20/2020

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Bricklayer Tile Terrazzo Marble Mason Mechanic	\$30.28		\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.60	\$60.74
Marble Layout Work	\$30.78		\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$46.10	\$61.49
Swing Scaffold Worker	\$31.78		\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$47.10	\$62.99
Apprentice after 2 years (2400 hrs) as Apprentice Finisher												
5th/6 Months 0-600 hrs.	70.00	\$21.20	\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$36.52	\$47.11
6th/6 months 601-1200 hrs.	75.00	\$22.71	\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.03	\$49.39
7th/6 months 1201-1800 hrs.	80.00	\$24.22	\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.54	\$51.66
8th/6 months 1801-2400 hrs.	90.00	\$27.25	\$9.47	\$5.29	\$0.56	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$42.57	\$56.20

Special Calculation Note : Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.

Note that the classification description is clarified after the local union number at the top of the

page.

Ratio :

1 Journeyman to 1 Apprentice
5 Journeymen to 1 Apprentice
10 Journeymen to 2 Apprentices
15 Journeymen to 3 Apprentices
20 Journeymen to 4 Apprentices
25 Journeymen to 5 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, BROWN, BUTLER, CLERMONT,
GALLIA, HAMILTON, LAWRENCE, PREBLE*,
SCIOTO, WARREN

Special Jurisdictional Note : In Preble County the Townships of Dixon, Israel, Gasper, Lanier, Somers and Gratis.

Details :

In order to utilize a Pre-Apprentice, you must have 1 Registered Apprentice in your employ.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Carpenter & Pile Driver SW District HevHwy

Change # : LCN01-2021fbLoc126

Craft : Carpenter Effective Date : 06/17/2021 Last Posted : 06/17/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Carpenter	\$31.62		\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$50.49	\$66.30
Pile Driver	\$29.34		\$6.63	\$6.95	\$0.40	\$0.00	\$1.97	\$0.10	\$0.00	\$0.00	\$45.39	\$60.06
Apprentice	Percent											
1st 6 Months	60.00	\$18.97	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$37.84	\$47.33
2nd 6 Months	65.00	\$20.55	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$39.42	\$49.70
3rd 6 Months	70.00	\$22.13	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$41.00	\$52.07
4th 6 Months	75.00	\$23.71	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$42.59	\$54.44
5th 6 Months	80.00	\$25.30	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$44.17	\$56.81
6th 6 Months	85.00	\$26.88	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$45.75	\$59.19
7th 6 Months	90.00	\$28.46	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$47.33	\$61.56
8th 6 Months	95.00	\$30.04	\$8.09	\$6.95	\$0.40	\$0.00	\$3.30	\$0.13	\$0.00	\$0.00	\$48.91	\$63.93

Special Calculation Note : Other is UBC National Fund.

Ratio :

1 Journeymen to 1 Apprentice

An employer shall have the right to employ one (1) Apprentice for one (1) Journeyman Carpenter in its employment for the first Apprentice employed, and 1 (1) Apprentice for two (2) Journeyman Carpenter for additional Apprentices employed.

Thereafter, every third additional carpenter hired shall be an apprentice, if available, and if practical for the type of work being performed.

Special Jurisdictional Note :

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CHAMPAIGN, CLARK, CLERMONT, CLINTON, DARKE, GREENE, HAMILTON, LOGAN, MIAMI, MONTGOMERY, PREBLE, SHELBY, WARREN

Details :

Highway Construction, Airport Construction, Heavy Construction but not limited to: (tunnels,subways,drainage projects,flood control,reservoirs). Railroad Construction,Sewer Waterworks & Utility Construction but not limited to: (storm sewers, waterlines, gaslines). Industrial & Building Site, Power Plant, Amusement Park, Athletic Stadium Site, Sewer and Water Plants.

When the Contractor furnishes the necessary underwater gear for the Diver, the Diver shall be paid one and one half (1&1/2) times the journeyman rate for the time spent in the water.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Carpenter & Pile Driver
SW Zone 2

Change # : LCN01-2021fbLoc126

Craft : Carpenter Effective Date : 07/14/2021 Last Posted : 07/14/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Carpenter	\$28.67		\$7.88	\$6.95	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$45.97	\$60.31
Pile Driver	\$25.84		\$6.62	\$6.95	\$0.40	\$0.00	\$0.91	\$0.10	\$0.00	\$0.00	\$40.82	\$53.74
Apprentice	Percent											
1st 3 Months	60.00	\$17.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$17.20	\$25.80
2nd 3 Months	60.00	\$17.20	\$7.88	\$0.00	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$27.55	\$36.15
2rd 6 Months	60.00	\$17.20	\$7.88	\$0.00	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$27.55	\$36.15
3rd 6 Months	65.00	\$18.64	\$7.88	\$0.00	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$28.99	\$38.30
4th 6 Months	65.00	\$18.64	\$7.88	\$0.00	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$28.99	\$38.30
5th 6 Months	70.00	\$20.07	\$7.88	\$6.95	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$37.37	\$47.40
6th 6 Months	75.00	\$21.50	\$7.88	\$6.95	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$38.80	\$49.55
7th 6 Months	80.00	\$22.94	\$7.88	\$6.95	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$40.24	\$51.70
8th 6 Months	85.00	\$24.37	\$7.88	\$6.95	\$0.43	\$0.00	\$1.91	\$0.13	\$0.00	\$0.00	\$41.67	\$53.85

Special Calculation Note : Other is for UBC National Fund.

Ratio :

After employing 1 Journeymen, the next carpenter employed may be an Apprentice. After the first apprentice is employed, the ratio of Apprentice to Journeymen shall not exceed 2 Journeymen for 1 Apprentice.

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, CLINTON, HAMILTON, WARREN

Special Jurisdictional Note :

Details :

Carpenter duties shall include but not limited to: Pile driving, milling, fashioning, joining, assembling, erecting, fastening, or dismantling of all material of wood, plastic, metal, fiber, cork, and composition, and all other substitute materials: pile driving, cutting, fitting, and placing of lagging, and the handling, cleaning, erecting, installing, and dismantling of machinery, equipment, and erecting pre-engineered metal buildings.

Pile Drivers work but not limited to: unloading, assembling, erection, repairs, operation, signaling, dismantling, and reloading all equipment that is used for pile driving including pile butts. pile butts is defined as sheeting or scrap piling. Underwater work that may be required in connection with the installation of piling. The diver and his tender work as a team and shall arrive at their own financial arrangements with the contractor. Any configuration of wood, steel, concrete, or composite that is jetted, driven, or vibrated onto the ground by conventional pile driving equipment for the purpose of supporting a future load that may be permanent or temporary.

Driving bracing, plumbing, cutting off and capping of all piling whether wood, metal, pipe piling or composite. loading, unloading, erecting, framing, dismantling, moving, and handling of pile driving equipment. piling used in the construction and repair of all wharves, docks, piers, trestles, caissons, cofferdams, and the erection of all sea walls and breakwaters. All underwater and marine work on bulkheads, wharves, docks, shipyards, caissons, piers, bridges, pipeline work, viaducts, marine cable and trestles, as well as salvage and reclamation work where divers are employed.

Rate shall include carpenters, acoustic, and ceiling installers, drywall installers, pile drivers, and floorlayers.

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Floorlayer SW District G

Change # : LCN01-2021sksLocSWDayton

Craft : Carpenter Effective Date : 10/06/2021 Last Posted : 10/06/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Carpenter Floorlayer	\$27.12		\$7.93	\$6.95	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$44.51	\$58.07
Apprentice	Percent											
1st 3 months	65.00	\$17.63	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$17.63	\$26.44
2nd 3 months	65.00	\$17.63	\$7.93	\$0.00	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$28.07	\$36.88
2nd 6 months	65.00	\$17.63	\$7.93	\$0.00	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$28.07	\$36.88
3rd 6 months	70.00	\$18.98	\$7.93	\$0.00	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$29.42	\$38.92
4th 6 months	75.00	\$20.34	\$7.93	\$0.00	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$30.78	\$40.95
5th 6 months	80.00	\$21.70	\$7.93	\$6.95	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$39.09	\$49.93
6th 6 months	85.00	\$23.05	\$7.93	\$6.95	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$40.44	\$51.97
7th 6 months	90.00	\$24.41	\$7.93	\$6.95	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$41.80	\$54.00
8th 6 months	95.00	\$25.76	\$7.93	\$6.95	\$0.43	\$0.00	\$1.95	\$0.13	\$0.00	\$0.00	\$43.15	\$56.04

Special Calculation Note : Other fs for UBC National Fund and Install

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CHAMPAIGN, CLARK, CLERMONT, CLINTON, DARKE, GREENE, HAMILTON, LOGAN, MIAMI, MONTGOMERY, PREBLE, SHELBY, WARREN

Special Jurisdictional Note :

Details :

Scope of work shall include, but not be limited to: receiving,unloading,handling,distribution and installation of all carpeting materials,carpet padding or matting materials and all resilient materials whether for use on walls,

Carpenter Floorlayer SW District G

floors, counter, sink, table and all preparation work necessary in connection therewith, including sanding work. the installation of nonstructural under-layment and the work of removing, cleaning waxing of any of the above. Carpeting shall include any floor covering composed of either natural or synthetic fibers that are made in breadths to be sewed, fastened or directly glued to floors or over cushioning sound-proofing materials. Resilient Floors shall consist of and include the laying of all special designs of wood, wood block, wood composition, cork, linoleum, asphalt, mastic, plastic, rubber tile, whether nailed or glued.

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Millwright Local 1090 SW Zone I

Change # : LCN01-2021sksLoc1066

Craft : Carpenter Effective Date : 09/22/2021 Last Posted : 09/22/2021

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Carpenter Millwright	\$31.68		\$7.93	\$6.95	\$0.49	\$0.00	\$6.94	\$0.16	\$0.00	\$0.00	\$54.15	\$69.99
Apprentice	Percent											
1st 6 months	60.00	\$19.01	\$7.93	\$4.27	\$0.49	\$0.00	\$4.16	\$0.16	\$0.00	\$0.00	\$36.02	\$45.52
2nd 6 months	65.00	\$20.59	\$7.93	\$4.61	\$0.49	\$0.00	\$4.51	\$0.16	\$0.00	\$0.00	\$38.29	\$48.59
3rd 6 months	70.00	\$22.18	\$7.93	\$4.94	\$0.49	\$0.00	\$4.86	\$0.16	\$0.00	\$0.00	\$40.56	\$51.64
4th 6 months	75.00	\$23.76	\$7.93	\$5.28	\$0.49	\$0.00	\$5.21	\$0.16	\$0.00	\$0.00	\$42.83	\$54.71
5th 6 months	80.00	\$25.34	\$7.93	\$5.61	\$0.49	\$0.00	\$5.55	\$0.16	\$0.00	\$0.00	\$45.08	\$57.76
6th 6 months	85.00	\$26.93	\$7.93	\$5.95	\$0.49	\$0.00	\$5.90	\$0.16	\$0.00	\$0.00	\$47.36	\$60.82
7th 6 months	90.00	\$28.51	\$7.93	\$6.28	\$0.49	\$0.00	\$6.25	\$0.16	\$0.00	\$0.00	\$49.62	\$63.88
8th 6 months	95.00	\$30.10	\$7.93	\$6.62	\$0.49	\$0.00	\$6.59	\$0.16	\$0.00	\$0.00	\$51.89	\$66.93

Special Calculation Note : Other (\$0.16) \$0.11 National Fund and National Millwright Fund \$0.05

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, CLINTON, HAMILTON, WARREN

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter NE District Industrial Dock & Door

Change # : LCN01-2014fbCarpNEStatewide

Craft : Carpenter Effective Date : 03/05/2014 Last Posted : 03/05/2014

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Carpenter	\$19.70		\$5.05	\$1.00	\$0.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$25.90	\$35.75
Trainee												
	Percent											
1st Year	60.00	\$11.82	\$5.05	\$1.00	\$0.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$18.02	\$23.93
2nd Year	80.20	\$15.80	\$5.05	\$1.00	\$0.15	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$22.00	\$29.90

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note : Industrial Dock and Door is the installation of overhead doors, roll up doors and dock leveling equipment

Details :

10/27/10 New Contract jc

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy A

Change # : LCN01-2021fbHvyHwy

Craft : Bricklayer Effective Date : 06/01/2021 Last Posted : 05/26/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Cement Mason Bricklayer Sewer Water Works A	\$30.40		\$9.50	\$7.57	\$0.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$47.95	\$63.15
Apprentice	Percent											
1st year	50.00	\$15.20	\$9.50	\$7.57	\$0.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$32.75	\$40.35
2nd year	70.00	\$21.28	\$9.50	\$7.57	\$0.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.83	\$49.47
3rd year	90.00	\$27.36	\$9.50	\$7.57	\$0.48	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$44.91	\$58.59

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

- 3 Journeymen to 1 Apprentice
- 6 Journeymen to 2 Apprentice
- 9 Journeymen to 3 Apprentice
- 12 Journeymen to 4 Apprentice
- 15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN

WERT, VINTON, WARREN, WASHINGTON,
WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.

(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy B

Change # : LCN01-2021fbHvyHwy

Craft : Bricklayer Effective Date : 06/01/2021 Last Posted : 05/26/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Cement Mason Bricklayer Power Plants Tunnels Amusement Parks B	\$31.39		\$9.50	\$7.57	\$0.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$48.95	\$64.64
Apprentice	Percent											
1st year	50.00	\$15.70	\$9.50	\$7.57	\$0.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$33.26	\$41.10
2nd year	70.00	\$21.97	\$9.50	\$7.57	\$0.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.53	\$50.52
3rd year	90.00	\$28.25	\$9.50	\$7.57	\$0.49	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.81	\$59.94

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

- 3 Journeymen to 1 Apprentice
- 6 Journeymen to 2 Apprentice
- 9 Journeymen to 2 Apprentice
- 12 Journeymen to 4 Apprentice
- 15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN

WERT, VINTON, WARREN, WASHINGTON,
WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.

(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Local 132 (Cincinnati)

Change # : LCN01-2021fbLoc132

Craft : Cement Effective Date : 07/14/2021 Last Posted : 07/14/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Cement Mason	\$28.00		\$7.15	\$6.50	\$0.65	\$0.00	\$0.10	\$0.00	\$0.00	\$0.00	\$42.40	\$56.40
Apprentice												
	Percent											
1st yr	70.00	\$19.60	\$7.15	\$6.50	\$0.65	\$0.00	\$0.10	\$0.00	\$0.00	\$0.00	\$34.00	\$43.80
2nd yr	80.00	\$22.40	\$7.15	\$6.50	\$0.65	\$0.00	\$0.10	\$0.00	\$0.00	\$0.00	\$36.80	\$48.00
3rd yr	90.00	\$25.20	\$7.15	\$6.50	\$0.65	\$0.00	\$0.10	\$0.00	\$0.00	\$0.00	\$39.60	\$52.20

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

- 1 Journeymen to 1 Apprentice
- 4 Journeymen to 2 Apprentice
- 7 Journeymen to 3 Apprentice
- 10 Journeymen to 4 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, HAMILTON, HIGHLAND, WARREN

Special Jurisdictional Note :

Details :

- *Cement Masons working on silo & slip form work shall receive \$.50 per hour over Journeyman scale.
- *Cement Masons working on swinging scaffolds shall receive \$.50 per hour over Journeyman scale.
- *Cement Masons working on high lifts from 20' and above shall receive \$.50 per hour over Journeyman scale.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Statewide HevHwy Exhibit A District II

Change # : OCN01-2021fbCementHevHwy

Craft : Cement Mason Effective Date : 05/01/2021 Last Posted : 04/23/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Cement Mason	\$31.15		\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$49.72	\$65.29
Apprentice	Percent											
1st Year	70.00	\$21.80	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$40.37	\$51.28
2nd Year	80.00	\$24.92	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$43.49	\$55.95
3rd Year	90.00	\$28.03	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$46.60	\$60.62

Special Calculation Note : Other \$0.07 is for International Training Fund

Ratio :

1 Journeymen to 1 Apprentice
2 to 1 thereafter

Jurisdiction (* denotes special jurisdictional note) :

ALLEN, AUGLAIZE, BROWN, BUTLER, CARROLL, CLERMONT, COLUMBIANA, DEFIANCE, ERIE, HAMILTON, HARDIN, HIGHLAND, HOLMES, HURON, LOGAN, LORAIN, MAHONING, MEDINA, MERCER, OTTAWA, PAULDING, PORTAGE, SANDUSKY, SENECA, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, VAN WERT, WARREN, WAYNE, WILLIAMS

Special Jurisdictional Note : (A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site, Heavy Construction, Airport Construction Or Railroad Construction Work.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Statewide HevHwy Exhibit B District II

Change # : OCN01-2021fbCementHevHwy

Craft : Cement Mason Effective Date : 05/01/2021 Last Posted : 04/23/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Cement Mason	\$32.02		\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$50.59	\$66.60
Apprentice Percent												
1st Year	70.00	\$22.41	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$40.98	\$52.19
2nd Year	80.00	\$25.62	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$44.19	\$56.99
3rd Year	90.00	\$28.82	\$8.25	\$7.35	\$0.65	\$0.00	\$2.25	\$0.07	\$0.00	\$0.00	\$47.39	\$61.80

Special Calculation Note : Other \$0.07 is for International Training Fund.

Ratio :

1 Journeymen to 1 Apprentice
2 to 1 thereafter

Jurisdiction (* denotes special jurisdictional note) :

ALLEN, AUGLAIZE, BROWN, BUTLER, CARROLL, CLERMONT, COLUMBIANA, DEFIANCE, ERIE, HAMILTON, HARDIN, HIGHLAND, HOLMES, HURON, LOGAN, LORAIN, MAHONING, MEDINA, MERCER, OTTAWA, PAULDING, PORTAGE, SANDUSKY, SENECA, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, VAN WERT, WARREN, WAYNE, WILLIAMS

Special Jurisdictional Note : (B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 High Tension Pipe Type Cable

Change # : LCN01-2021fbLoc7

Craft : Lineman Effective Date : 03/16/2021 Last Posted : 03/16/2021

BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Electrical Lineman	\$45.61	\$6.75	\$1.37	\$0.46	\$0.00	\$10.95	\$0.60	\$0.00	\$0.00	\$65.74	\$88.54
Certified Lineman Welder	\$45.61	\$6.75	\$1.37	\$0.46	\$0.00	\$10.95	\$0.60	\$0.00	\$0.00	\$65.74	\$88.54
Certified Cable Splicer	\$45.61	\$6.75	\$1.37	\$0.46	\$0.00	\$10.95	\$0.60	\$0.00	\$0.00	\$65.74	\$88.54
Operator A	\$40.88	\$6.75	\$1.23	\$0.41	\$0.00	\$9.81	\$0.60	\$0.00	\$0.00	\$59.68	\$80.12
Operator B	\$36.20	\$6.75	\$1.09	\$0.36	\$0.00	\$8.69	\$0.60	\$0.00	\$0.00	\$53.69	\$71.79
Operator C	\$29.12	\$6.75	\$0.87	\$0.29	\$0.00	\$6.99	\$0.60	\$0.00	\$0.00	\$44.62	\$59.18
Groundman 0-12 months Exp	\$22.81	\$6.75	\$0.68	\$0.23	\$0.00	\$5.47	\$0.60	\$0.00	\$0.00	\$36.54	\$47.94
Groundman 0-12 months Exp w/CDL	\$25.09	\$6.75	\$0.75	\$0.25	\$0.00	\$6.02	\$0.60	\$0.00	\$0.00	\$39.46	\$52.01
Groundman 1 yr or more	\$25.09	\$6.75	\$0.75	\$0.25	\$0.00	\$6.02	\$0.60	\$0.00	\$0.00	\$39.46	\$52.01
Groundman 1 yr or more w/CDL	\$29.65	\$6.75	\$0.85	\$0.28	\$0.00	\$6.50	\$0.60	\$0.00	\$0.00	\$44.63	\$59.46
Equipment Mechanic A	\$36.20	\$6.75	\$1.09	\$0.36	\$0.00	\$8.69	\$0.60	\$0.00	\$0.00	\$53.69	\$71.79
Equipment Mechanic B	\$32.66	\$6.75	\$0.98	\$0.33	\$0.00	\$7.84	\$0.60	\$0.00	\$0.00	\$49.16	\$65.49
Equipment Mechanic C	\$29.12	\$6.75	\$0.87	\$0.29	\$0.00	\$6.99	\$0.60	\$0.00	\$0.00	\$44.62	\$59.18
X-Ray Technician	\$45.61	\$6.75	\$1.37	\$0.46	\$0.00	\$10.95	\$0.60	\$0.00	\$0.00	\$65.74	\$88.54
Apprentice	Percent										
1st 1000 hrs	60.00	\$27.37	\$6.75	\$0.82	\$0.27	\$6.57	\$0.60	\$0.00	\$0.00	\$42.38	\$56.06
2nd 1000 hrs	65.00	\$29.65	\$6.75	\$0.89	\$0.30	\$7.12	\$0.60	\$0.00	\$0.00	\$45.31	\$60.13

Electrical Local 71 High Tension Pipe Type Cable

3rd 1000 hrs	70.00	\$31.93	\$6.75	\$0.96	\$0.32	\$0.00	\$7.66	\$0.60	\$0.00	\$0.00	\$48.22	\$64.18
4th 1000 hrs	75.00	\$34.21	\$6.75	\$1.03	\$0.34	\$0.00	\$8.21	\$0.60	\$0.00	\$0.00	\$51.14	\$68.24
5th 1000 hrs	80.00	\$36.49	\$6.75	\$1.09	\$0.36	\$0.00	\$8.76	\$0.60	\$0.00	\$0.00	\$54.05	\$72.29
6th 1000 hrs	85.00	\$38.77	\$6.75	\$1.16	\$0.39	\$0.00	\$9.30	\$0.60	\$0.00	\$0.00	\$56.97	\$76.35
7th 1000 hrs	90.00	\$41.05	\$6.75	\$1.23	\$0.41	\$0.00	\$9.85	\$0.60	\$0.00	\$0.00	\$59.89	\$80.41

Special Calculation Note : Other is Health Retirement Account

Operator "A"

John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater than 25 tons and less than 45 tons).

Operator "B"

Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger-wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"

Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

*All Operators of cranes 45 ton or larger shall be paid the journeyman rate of pay. \$0.30 is for Health Retirement Account.

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Heli - Arc Welding will be paid \$.30 above Journeyman rate. Additional compensation of 10% over the Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Electrical Local 71 Outside Cincinnati

1st 1,000 Hours	60.00	\$24.19	\$6.75	\$0.73	\$0.24	\$0.00	\$4.60	\$0.06	\$0.00	\$0.00	\$36.57	\$48.66
2nd 1,000 Hours	65.00	\$26.20	\$6.75	\$0.79	\$0.26	\$0.00	\$4.98	\$0.06	\$0.00	\$0.00	\$39.04	\$52.14
3rd 1,000 Hours	70.00	\$28.22	\$6.75	\$0.85	\$0.28	\$0.00	\$5.36	\$0.06	\$0.00	\$0.00	\$41.52	\$55.63
4th 1,000 Hours	75.00	\$30.23	\$6.75	\$0.91	\$0.30	\$0.00	\$5.74	\$0.06	\$0.00	\$0.00	\$43.99	\$59.11
5th 1,000 Hours	80.00	\$32.25	\$6.75	\$0.97	\$0.32	\$0.00	\$6.13	\$0.06	\$0.00	\$0.00	\$46.48	\$62.60
6th 1,000 Hours	85.00	\$34.26	\$6.75	\$1.03	\$0.34	\$0.00	\$6.51	\$0.06	\$0.00	\$0.00	\$48.95	\$66.09
7th 1,000 Hours	90.00	\$36.28	\$6.75	\$1.09	\$0.36	\$0.00	\$6.89	\$0.06	\$0.00	\$0.00	\$51.43	\$69.57

Special Calculation Note : Other is Safety & Education Fund.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, HAMILTON, WARREN

Special Jurisdictional Note :

Details :

A groundman when directed shall assist a Journeyman in the performance of his/her work on the ground, including the use of hand tools. A Groundman under no circumstances shall climb poles, towers, ladders, or work from an elevated platform or bucket truck.

No more than three (3) Groundmen shall work alone. Jobs with more than three Groundmen shall be supervised by a Groundcrew Foreman, Journeyman Lineman, Journeyman Traffic Signal Technician or an Equipment Operator.

Scope of Work: installation and maintenance of highway and street lighting, highway and street sign lighting, electronic message boards and traffic control systems, camera systems, traffic signal work, substation and line construction including overhead and underground projects for private and industrial work as in accordance with the IBEW Constitution. This Agreement includes the operation of all tools and equipment necessary for the installation of the above projects.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 Outside Utility Power

Change # : LCN01-2021fbLoc7

Craft : Lineman Effective Date : 03/16/2021 Last Posted : 03/16/2021

Classification	BHR	Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate		
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)			
Electrical Lineman	\$43.22	\$6.75	\$1.30	\$0.43	\$0.00	\$10.37	\$0.60	\$0.00	\$0.00	\$62.67	\$84.28	
Substation Technician	\$43.22	\$6.75	\$1.30	\$0.43	\$0.00	\$10.37	\$0.60	\$0.00	\$0.00	\$62.67	\$84.28	
Cable Splicer	\$45.26	\$6.75	\$1.36	\$0.45	\$0.00	\$10.86	\$0.60	\$0.00	\$0.00	\$65.28	\$87.91	
Operator A	\$38.75	\$6.75	\$1.16	\$0.39	\$0.00	\$9.30	\$0.60	\$0.00	\$0.00	\$56.95	\$76.32	
Operator B	\$34.27	\$6.75	\$1.03	\$0.34	\$0.00	\$8.22	\$0.60	\$0.00	\$0.00	\$51.21	\$68.34	
Operator C	\$27.54	\$6.75	\$0.83	\$0.28	\$0.00	\$6.61	\$0.60	\$0.00	\$0.00	\$42.61	\$56.38	
Groundman 0-12 months Exp	\$21.61	\$6.75	\$0.65	\$0.22	\$0.00	\$5.19	\$0.60	\$0.00	\$0.00	\$35.02	\$45.82	
Groundman 0-12 months Exp w/CDL	\$23.77	\$6.75	\$0.71	\$0.24	\$0.00	\$5.70	\$0.60	\$0.00	\$0.00	\$37.77	\$49.66	
Groundman 1 yr or more	\$23.77	\$6.75	\$0.71	\$0.24	\$0.00	\$5.70	\$0.60	\$0.00	\$0.00	\$37.77	\$49.66	
Groundman 1 yr or more w/CDL	\$28.09	\$6.75	\$0.84	\$0.28	\$0.00	\$6.74	\$0.60	\$0.00	\$0.00	\$43.30	\$57.35	
Equipment Mechanic A	\$34.27	\$6.75	\$1.03	\$0.34	\$0.00	\$8.22	\$0.60	\$0.00	\$0.00	\$51.21	\$68.34	
Equipment Mechanic B	\$30.91	\$6.75	\$0.93	\$0.31	\$0.00	\$7.42	\$0.60	\$0.00	\$0.00	\$46.92	\$62.38	
Equipment Mechanic C	\$27.54	\$6.75	\$0.83	\$0.28	\$0.00	\$6.61	\$0.60	\$0.00	\$0.00	\$42.61	\$56.38	
Line Truck w/uuger	\$30.44	\$6.75	\$0.91	\$0.30	\$0.00	\$7.31	\$0.60	\$0.00	\$0.00	\$46.31	\$61.53	
Apprentice	Percent											
1st 1000 hrs	60.00	\$25.93	\$6.75	\$0.78	\$0.26	\$0.00	\$6.22	\$0.60	\$0.00	\$0.00	\$40.54	\$53.51
2nd 1000 hrs	65.00	\$28.09	\$6.75	\$0.84	\$0.28	\$0.00	\$6.74	\$0.60	\$0.00	\$0.00	\$43.30	\$57.35

Electrical Local 71 Outside Utility Power

3rd 1000 hrs	70.00	\$30.25	\$6.75	\$0.91	\$0.30	\$0.00	\$7.26	\$0.60	\$0.00	\$0.00	\$46.07	\$61.20
4th 1000 hrs	75.00	\$32.42	\$6.75	\$0.97	\$0.32	\$0.00	\$7.78	\$0.60	\$0.00	\$0.00	\$48.84	\$65.04
5th 1000 hrs	80.00	\$34.58	\$6.75	\$1.04	\$0.35	\$0.00	\$8.30	\$0.60	\$0.00	\$0.00	\$51.62	\$68.90
6th 1000 hrs	85.00	\$36.74	\$6.75	\$1.10	\$0.37	\$0.00	\$8.82	\$0.60	\$0.00	\$0.00	\$54.38	\$72.75
7th 1000 hrs	90.00	\$38.90	\$6.75	\$1.17	\$0.39	\$0.00	\$9.34	\$0.60	\$0.00	\$0.00	\$57.15	\$76.60

Special Calculation Note : Other is Health Retirement Account

Operator "A"

John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater than 25 tons and less than 45 tons).

Operator "B"

Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger- wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"

Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

Ratio :

(1) Journeyman Lineman to (1) Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note : 0.30 is for Health Retirement Account.

Details :

Heli - Arc Welding will be paid \$.30 above Journeyman rate. Additional compensation of 10% over the Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 Voice Data Video Outside

Change # : LCR01-2017fbLoc71VDV

Craft : Voice Data Video Effective Date : 10/18/2017 Last Posted : 10/18/2017

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Electrical Installer Technician I	\$23.46	\$5.50	\$0.70	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$29.96	\$41.69
Installer Technician II	\$22.37	\$5.50	\$0.67	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$28.84	\$40.03
Equipment Operator I	\$22.37	\$5.50	\$0.67	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$28.84	\$40.03
Equipment Operator II	\$18.43	\$5.50	\$0.55	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$24.78	\$33.99
Installer /Repair Outside	\$22.37	\$5.50	\$0.67	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$28.84	\$40.03
Ground Driver W/CDL	\$15.83	\$5.50	\$0.47	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$22.10	\$30.01
Groundman	\$13.24	\$5.50	\$0.40	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$19.44	\$26.06
Cable Splicer	\$23.46	\$5.50	\$0.70	\$0.00	\$0.00	\$0.30	\$0.00	\$0.00	\$0.00	\$29.96	\$41.69

Special Calculation Note :

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Cable Splicer: Inspect and test lines or cables, analyze results, and evaluate transmission characteristics. Cover conductors with insulation or seal splices with moisture-proof covering. Install, splice, test, and repair cables using tools or mechanical equipment. This will include the splicing of fiber.

Journeyman Technician I: Must know all aspects of telephone and cable work. This is to include aerial, underground, and manhole work. Must know how to climb and run bucket. Must have all the tools required to perform these tasks. Must be able to be responsible for the safety of the crew at all times. Must also have CDL license and have at least 5 years experience.

Installer/Repairman: Perform tasks of repairing, installing, and testing phone and CATV services.

Technician II: Have at least three years of telephone and CATV experience. Must have the knowledge of underground, aerial, and manhole work. Must be able to climb and operate bucket. Must have CDL. Must have all tools needed to perform these tasks.

Equipment Operator I: Able to operate a digger derrick or bucket truck. Have at least 5 years of experience and must have a valid CDL license.

Equipment Operator II: Able to operate a digger derrick or bucket truck. Have at least 3 years of experience and must have a valid CDL license.

Groundman W/CDL: Must have a valid CDL license and be able to perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Must have at least 5 year's experience.

Groundman: Perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Experience 0-5 years.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 82 Inside

Change # : LCN01-2021sksLoc82in

Craft : Electrical Effective Date : 11/29/2021 Last Posted : 11/24/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Electrician	\$33.25		\$7.45	\$9.35	\$0.57	\$0.00	\$3.50	\$0.00	\$0.00	\$0.00	\$54.12	\$70.74
Apprentice	Percent											
1st period 0 - 1000 hrs	42.00	\$13.97	\$4.07	\$0.62	\$0.24	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$18.89	\$25.88
2nd period 1001-2000 hrs	42.00	\$13.97	\$4.07	\$0.62	\$0.24	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$18.89	\$25.88
3rd period 2001-3500 hrs	47.00	\$15.63	\$6.92	\$4.39	\$0.27	\$0.00	\$1.65	\$0.00	\$0.00	\$0.00	\$28.86	\$36.67
4th period 3501-5000 hrs	52.00	\$17.29	\$6.97	\$4.86	\$0.29	\$0.00	\$1.82	\$0.00	\$0.00	\$0.00	\$31.23	\$39.88
5th period 5001-6500 hrs	62.03	\$20.62	\$7.07	\$5.80	\$0.35	\$0.00	\$2.17	\$0.00	\$0.00	\$0.00	\$36.01	\$46.33
6th period 6501-8000 hrs	77.00	\$25.60	\$7.22	\$7.20	\$0.44	\$0.00	\$2.70	\$0.00	\$0.00	\$0.00	\$43.16	\$55.96

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 to 3 Journeymen to 3 Apprentices
4 to 6 Journeymen to 6 Apprentices
per job site

Jurisdiction (* denotes special jurisdictional note) :

CLINTON, DARKE, GREENE, MIAMI,
MONTGOMERY, PREBLE, WARREN*

Special Jurisdictional Note : The following townships in Warren County are included: Clearcreek, Franklin and Wayne.

Details :

Only correction made on 6-19-19 was the 5th year Apprentice fb.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Electrical Local 82 Inside Lt Commercial South West

Change # : LCNO2-2020fbLoc82in

Craft : Electrical Effective Date : 01/01/2021 Last Posted : 12/24/2020

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Electrician	\$32.15		\$6.35	\$9.31	\$0.68	\$0.00	\$3.20	\$0.00	\$0.00	\$0.00	\$51.69	\$67.76
CE-3 12,001-14,000	\$23.03		\$6.35	\$0.69	\$0.68	\$0.00	\$0.68	\$0.00	\$0.00	\$0.10	\$31.53	\$43.05
CE-2 10,001-12,000 Hrs	\$18.10		\$6.35	\$0.54	\$0.68	\$0.00	\$0.54	\$0.00	\$0.00	\$0.10	\$26.31	\$35.36
CE-1 8,001-10,000 Hrs	\$16.45		\$6.35	\$0.49	\$0.68	\$0.00	\$0.49	\$0.00	\$0.00	\$0.10	\$24.56	\$32.79
CW-4 6,001-8,000 Hrs	\$14.81		\$6.35	\$0.44	\$0.68	\$0.00	\$0.44	\$0.00	\$0.00	\$0.10	\$22.82	\$30.23
CW-3 4,001-6,000 Hrs	\$13.16		\$6.35	\$0.39	\$0.68	\$0.00	\$0.39	\$0.00	\$0.00	\$0.10	\$21.07	\$27.65
CW-2 2,001-4,000 Hrs	\$12.34		\$6.35	\$0.37	\$0.68	\$0.00	\$0.37	\$0.00	\$0.00	\$0.10	\$20.21	\$26.38
CW-1 0-2,000 Hrs	\$11.52		\$6.35	\$0.35	\$0.68	\$0.00	\$0.35	\$0.00	\$0.00	\$0.10	\$19.35	\$25.11
Apprentice	Percent											
1st period 0 - 1000 hrs	42.00	\$13.50	\$4.07	\$0.20	\$0.23	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$18.00	\$24.75
2nd period 1001-2000 hrs	42.00	\$13.50	\$4.07	\$0.20	\$0.23	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$18.00	\$24.75
3rd period 2001-3500 hrs	47.00	\$15.11	\$6.92	\$3.92	\$0.26	\$0.00	\$1.50	\$0.00	\$0.00	\$0.00	\$27.71	\$35.27
4th period 3501-5000 hrs	52.00	\$16.72	\$6.97	\$4.34	\$0.28	\$0.00	\$1.66	\$0.00	\$0.00	\$0.00	\$29.97	\$38.33
5th period 5001-6500 hrs	62.00	\$19.93	\$7.07	\$5.18	\$0.34	\$0.00	\$1.98	\$0.00	\$0.00	\$0.00	\$34.50	\$44.47
6th period 6501-8000 hrs	77.00	\$24.76	\$7.22	\$6.43	\$0.42	\$0.00	\$2.46	\$0.00	\$0.00	\$0.00	\$41.29	\$53.66

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 to 3 Journeymen to 3 Apprentices
4 to 6 Journeymen to 6 Apprentices
per job site

Jurisdiction (* denotes special jurisdictional note) :

CLINTON, DARKE, GREENE, MIAMI,
MONTGOMERY, PREBLE, WARREN*

Construction Electrician and Construction Wireman Ratio

There shall be a minimum ratio of one inside Journeyman to every (4) employees of different classification per jobsite. An inside Journeyman Wireman is required on the project as the fifth (5th) worker or when apprentices are used.

Special Jurisdictional Note : The following townships in Warren County are included: Clearcreek, Franklin and Wayne.

The scope of work for the light commercial agreement shall apply to the following facilities not to exceed 200,000 square feet; office buildings, shopping centers, auto sales agencies and garages, churches, funeral homes, nursing homes, hotels, retail and wholesale facilities, small stand-alone manufacturing facilities when free standing and not part of a larger facility (not to exceed 50,000 square feet), solar projects (500 panels or less) unless otherwise covered under the agreement, lighting retrofits (when not associated with remodels involving branch re-circuiting) lighting retrofits shall be defined as the changing of lamps and ballasts in existing light fixtures and shall also include the one for one replacement of existing fixtures, warehouses, gas stations, food service centers, restaurants, entertainment facilities, hospitals, clinics, motels, residential buildings.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 82 Lightning Rod

Change # : LCR01-2022sksLoc82

Craft : Electrical Effective Date : 01/05/2022 Last Posted : 01/05/2022

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Electrical Lightning Rod Technican	\$31.79	\$7.45	\$9.30	\$0.00	\$0.00	\$3.50	\$0.00	\$0.00	\$0.00	\$52.04	\$67.93

Special Calculation Note : No Apprentice approved by OSAC.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

CLINTON, DARKE, GREENE, MIAMI,
MONTGOMERY, PREBLE, WARREN*

Special Jurisdictional Note : The following townships in Warren County are included: (Clearcreek, Franklin and Wayne)

Details :

Prevailing Wage Rate

Skilled Crafts

Name of Union: Electrical Local 82 Voice Data Video

Change # : LCN01-2021sksLoc82VDV

Craft : Voice Data Video Effective Date : 11/29/2021 Last Posted : 11/24/2021

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Electrical Installer Technician A	\$25.95	\$6.60	\$0.78	\$0.49	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$38.22	\$51.20
Electrical Installer Technician B	\$24.65	\$6.60	\$0.74	\$0.47	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$36.86	\$49.18
JW Installer Technician	\$23.36	\$6.60	\$0.70	\$0.44	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$35.50	\$47.18
NON BICSI Installer	\$16.87	\$3.00	\$0.51	\$0.32	\$0.00	\$2.00	\$0.00	\$0.00	\$0.00	\$22.70	\$31.14
Apprentice Indentured Before 09-03-2018											
1st Period 0-1000 Hrs	\$12.98	\$6.60	\$0.39	\$0.25	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$20.47	\$26.96
2nd Period 1001-2000 Hrs	\$12.98	\$6.60	\$0.39	\$0.25	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$20.47	\$26.96
3rd Period 2001-3000 Hrs	\$15.57	\$6.60	\$0.47	\$0.30	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$27.34	\$35.13
4th Period 3001-4000Hrs	\$16.87	\$6.60	\$0.51	\$0.32	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$28.70	\$37.14
5th Period 4001-5000 Hrs	\$18.17	\$6.60	\$0.55	\$0.35	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$30.07	\$39.16
6th Period 5001-6000 Hrs	\$19.46	\$6.60	\$0.58	\$0.37	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$31.41	\$41.14
Cable Puller	\$12.98	\$3.00	\$0.39	\$0.25	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$16.87	\$23.36

Electrical Local 82 Voice Data Video

Apprentice Indentured After 09-04-2018	Percent											
1st 0-1000 hours	55.00	\$14.27	\$3.00	\$0.43	\$0.27	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$18.22	\$25.36
2nd 1001-2000 hours	55.00	\$14.27	\$3.00	\$0.43	\$0.27	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$18.22	\$25.36
3rd 2001-3000 hours	65.00	\$16.87	\$6.50	\$0.51	\$0.32	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$28.60	\$37.03
4th 3001-4000 hours	65.00	\$16.87	\$6.50	\$0.51	\$0.32	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$28.60	\$37.03
5th 4001-5000 hours	75.00	\$19.46	\$6.53	\$0.58	\$0.37	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$31.34	\$41.07
6th 5001-6000 hours	75.00	\$19.46	\$6.53	\$0.58	\$0.37	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$31.34	\$41.07
7th 6001-7000 hours	80.00	\$20.76	\$6.54	\$0.62	\$0.39	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$32.71	\$43.09
8th 7001 hours	80.00	\$20.76	\$6.54	\$0.62	\$0.39	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$32.71	\$43.09
Cable Puller	50.00	\$12.98	\$3.00	\$0.39	\$0.25	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$16.86	\$23.35

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 2 Apprentice
(Indentured After 9-4-2018)

1 Journeymen to 2 Apprentice
(Indentured Before 9--03-2018)

Jurisdiction (* denotes special jurisdictional note) :

CLINTON, DARKE, GREENE, MIAMI, MONTGOMERY, PREBLE, WARREN*

Special Jurisdictional Note : The following townships in Warren County are included: (Clearcreek, Franklin and Wayne)

Details :

Work covered but not limited to: installation which utilize transmission and/or transference of voice, sound, vision or digital for commercial, education, security and entertainment purposes for the following:

TV monitoring and surveillance, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multimedia, multiplex, nurse call system, radio page, school intercom, sound and low voltage master clock systems.

Fire Alarm work is excluded on all new construction sites or wherever the fire alarm system is installed in conduit.

All HVAC control work is not covered by this wage rate but by the Inside Electrical wage rate.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 648 Inside

Change # : LCN01-2021sksLoc648in

Craft : Electrical Effective Date : 09/15/2021 Last Posted : 09/15/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Electrician	\$32.00		\$7.25	\$8.05	\$0.48	\$0.00	\$4.05	\$0.96	\$0.00	\$0.00	\$52.79	\$68.79
Apprentice	Percent											
1st period 0-1000 hrs	45.00	\$14.40	\$4.22	\$0.00	\$0.22	\$0.00	\$2.82	\$0.43	\$0.00	\$0.00	\$22.09	\$29.29
2nd period 1001- 2000 hrs	47.00	\$15.04	\$4.22	\$0.00	\$0.23	\$0.00	\$2.83	\$0.45	\$0.00	\$0.00	\$22.77	\$30.29
3rd period 2001- 3500 hrs	51.00	\$16.32	\$7.25	\$4.11	\$0.24	\$0.00	\$3.29	\$0.49	\$0.00	\$0.00	\$31.70	\$39.86
4th period 3501- 5000 hrs	55.00	\$17.60	\$7.25	\$4.43	\$0.26	\$0.00	\$3.36	\$0.53	\$0.00	\$0.00	\$33.43	\$42.23
5th period 5001- 6500 hrs	62.00	\$19.84	\$7.25	\$4.99	\$0.30	\$0.00	\$3.46	\$0.60	\$0.00	\$0.00	\$36.44	\$46.36
6th period 6501- 8000 hrs	71.00	\$22.72	\$7.25	\$5.72	\$0.34	\$0.00	\$3.61	\$0.68	\$0.00	\$0.00	\$40.32	\$51.68

Special Calculation Note : Other is NEBF (Natioanl Electrical Benifit Fund.)

Ratio :

3 Journeyman to 2 Apprentices or fraction thereof:
 1-3 Journeymen to 2 Apprentice
 4-6 Journeymen to 4 Apprentice
 7-9 Journeymen to 6 Apprentice
 first person assigned to any job site shall be a journeyman

Jurisdiction (* denotes special jurisdictional note) :

BUTLER, WARREN*

Special Jurisdictional Note : In Warren County the following townships are included: (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union, and Washington)

Details :

Electricians while splicing cable shall receive \$.50 an hour above the regular electrical rate.

All work that requires the use of gas masks or respirators, shall be paid 50% above the appropriate rate of pay. Work up to & including 40 feet shall be paid \$.50 over the journeyman rate. All work from a Boatswain Chair, Swinging Scaffold, or Barrel shall be at double the Journeyman rate. Workmen required to work 50 feet or more below the surface of the earth will be paid 50% above the Journeyman rate.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 648 Lt Commercial South West

Change # : LCN01-2021sksLoc648in

Craft : Electrical Effective Date : 01/01/2022 Last Posted : 12/22/2021

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Electrician	\$32.00	\$7.25	\$8.05	\$0.48	\$0.00	\$4.05	\$0.12	\$0.00	\$0.00	\$51.95	\$67.95
CE-3 12,001- 14,000 Hrs	\$24.66	\$6.47	\$0.74	\$0.72	\$0.00	\$0.74	\$0.12	\$0.00	\$0.00	\$33.45	\$45.78
CE-2 10,001- 12,000 Hrs	\$19.56	\$6.47	\$0.59	\$0.72	\$0.00	\$0.59	\$0.12	\$0.00	\$0.00	\$28.05	\$37.83
CE-1 8,001- 10,000 Hrs	\$17.86	\$6.47	\$0.54	\$0.72	\$0.00	\$0.54	\$0.12	\$0.00	\$0.00	\$26.25	\$35.18
CW-4 6,001- 8,000 Hrs	\$16.16	\$6.47	\$0.48	\$0.72	\$0.00	\$0.48	\$0.12	\$0.00	\$0.00	\$24.43	\$32.51
CW-3 4,001- 6,000 Hrs	\$14.46	\$6.47	\$0.43	\$0.72	\$0.00	\$0.43	\$0.12	\$0.00	\$0.00	\$22.63	\$29.86
CW-2 2,001- 4,000 Hrs	\$13.61	\$6.47	\$0.41	\$0.72	\$0.00	\$0.41	\$0.12	\$0.00	\$0.00	\$21.74	\$28.54
CW-1 0- 2,000 Hrs	\$12.76	\$6.47	\$0.38	\$0.72	\$0.00	\$0.38	\$0.12	\$0.00	\$0.00	\$20.83	\$27.21

Special Calculation Note : Other is for NEBF (National Electrical Benefit Fund)

Ratio :

Construction Electrician and Construction Wireman
Ratio

There shall be a minimum ratio of one inside
Journeyman to every (4) employees of different
classification per jobsite. An inside Journeyman
Wireman is required on the project as the fifth (5th)
worker or when apprentices are used

Jurisdiction (* denotes special jurisdictional note) :

BUTLER, WARREN*

Special Jurisdictional Note : In Warren County the following townships are included: (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union, and Washington)

The scope of work for the light commercial agreement shall apply to the following facilities not to exceed 200,000 square feet; office buildings, shopping centers, auto sales agencies and garages, churches, funeral homes, nursing homes, hotels, retail and wholesale facilities, small stand-alone manufacturing facilities when free standing and not part of a larger facility (not to exceed 50,000 square fee), solar projects (500 panels or less) unless otherwise covered under the agreement, lighting retrofits (when not associated with remodels involving branch re-circuiting) lighting retrofits shall be defined as the changing of lamps and ballasts in existing light fixtures and shall also include the one for one replacement of existing fixtures, warehouses, gas stations, food service centers, restaurants, entertainment facilities, hospitals, clinics, motels, residential buildings.

Details :

Electricians while splicing cable shall receive \$.50 an hour above the regular electrical rate.

All work that requires the use of gas masks or respirators, shall be paid 50% above the appropriate rate of pay. Work up to & including 40 feet shall be paid \$.50 over the journeyman rate. All work from a Boatswain Chair, Swinging Scaffold, or Barrel shall be at double the Journeyman rate. Workmen required to work 50 feet or more below the surface of the earth will be paid 50% above the Journeyman rate.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 648 Voice Date Video

Change # : LCR01-2021sksLoc648VDV

Craft : Voice Data Video Effective Date : 12/22/2021 Last Posted : 12/22/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Electrical Installer Technician A	\$25.95		\$6.60	\$0.78	\$0.49	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$38.22	\$51.20
Electrical Installer Technician B	\$24.65		\$6.60	\$0.74	\$0.47	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$36.86	\$49.18
JW Installer Technician B	\$23.36		\$6.60	\$0.70	\$0.44	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$35.50	\$47.18
Non BICSI Installer	\$16.87		\$3.00	\$0.51	\$0.32	\$0.00	\$2.40	\$0.00	\$0.00	\$0.00	\$23.10	\$31.53
Apprentice												
	Percent											
1st period 0-800 hrs	55.00	\$14.27	\$3.00	\$0.43	\$0.27	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$18.22	\$25.36
2nd period 801-1600 hrs	55.00	\$14.27	\$3.00	\$0.43	\$0.27	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$18.22	\$25.36
3rd period 1601-2400 hrs	65.00	\$16.87	\$6.50	\$0.51	\$0.32	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$28.60	\$37.03
4th period 2401-3200 hrs	65.00	\$16.87	\$6.50	\$0.51	\$0.32	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$28.60	\$37.03
5th period 3201-4000 hrs	75.00	\$19.46	\$6.53	\$0.58	\$0.37	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$31.34	\$41.07
6th period 4001-4800 hrs	75.00	\$19.46	\$6.53	\$0.58	\$0.37	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$31.34	\$41.07
7th period 4801-4900hr	80.00	\$20.76	\$6.54	\$0.62	\$0.39	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$32.71	\$43.09
8th period 4901-5000hrs	80.00	\$20.76	\$6.54	\$0.62	\$0.39	\$0.00	\$4.40	\$0.00	\$0.00	\$0.00	\$32.71	\$43.09
Cable Puller	50.00	\$12.98	\$3.00	\$0.39	\$0.25	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$16.86	\$23.35

Special Calculation Note :

Ratio :

1 Technician to 2 Apprentice

Jurisdiction (* denotes special jurisdictional note)

:

BUTLER, WARREN*

Special Jurisdictional Note : The following townships In Warren County are included: (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union, and Washington)

Details :

The following work is excluded from the Teledata Technician work scope:

*The installation of computer systems in industrial applications such as assembly lines, robotics, computer controller manufacturing systems.

*The installation of conduit and/or raceways shall be installed by Inside Wireman. On sites where there is no Inside Wireman employed, the

Teledata Technician may install raceway or conduit not greater than 10 ft.

*Fire Alarm work is excluded on all new construction sites or wherever the fire alarm system is installed in conduit

*All HVAC control work.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Elevator Local 11

Change # : LCN01-2020fbLoc11

Craft : Elevator Effective Date : 01/05/2021 Last Posted : 01/05/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Elevator Mechanic	\$48.82		\$15.88	\$10.46	\$0.64	\$3.91	\$8.85	\$1.56	\$0.00	\$0.00	\$90.12	\$114.53
Probationary Apprentice	50.00	\$24.41	\$0.00	\$0.00	\$0.00	\$1.46	\$0.00	\$0.78	\$0.00	\$0.00	\$26.65	\$38.86
1st year	55.00	\$26.85	\$15.88	\$10.46	\$0.64	\$1.61	\$8.85	\$0.86	\$0.00	\$0.00	\$65.15	\$78.58
2nd year	65.00	\$31.73	\$15.88	\$10.46	\$0.64	\$1.90	\$8.85	\$1.02	\$0.00	\$0.00	\$70.48	\$86.35
3rd year	70.00	\$34.17	\$15.88	\$10.46	\$0.64	\$2.05	\$8.85	\$1.09	\$0.00	\$0.00	\$73.14	\$90.23
4th year	80.00	\$39.06	\$15.88	\$10.46	\$0.64	\$2.34	\$8.85	\$1.25	\$0.00	\$0.00	\$78.48	\$98.00
Helper	70.00	\$34.17	\$15.88	\$10.46	\$0.64	\$2.05	\$8.85	\$1.09	\$0.00	\$0.00	\$73.14	\$90.23
Assistant Mechanic	80.00	\$39.06	\$15.88	\$10.46	\$0.64	\$2.34	\$8.85	\$1.25	\$0.00	\$0.00	\$78.48	\$98.00

Special Calculation Note : Other is Holiday Pay. Vacation calculated at 6%.

Ratio :

The total number of Helpers & Apprentices employed shall not exceed the number of Mechanics on any one job, except on jobs where (2) teams or more are working, (1) extra Helper or Apprentice may be employed for the first (2) teams and an extra Helper or Apprentice for each additional (3) teams.

- 1 Journeymen to 1 Apprentice
- 2 Journeymen to 5 Apprentice
- 3 Journeymen to 6 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, BROWN, BUTLER, CLERMONT, CLINTON, DARKE, GREENE, HAMILTON, HIGHLAND, MIAMI, MONTGOMERY, PREBLE, SCIOTO, SHELBY, WARREN

Special Jurisdictional Note :**Details :**

Prevailing Wage Rate Skilled Crafts

Name of Union: Glazier Local 387

Change # : LCN01-2020fbLoc387

Craft : Glazier Effective Date : 11/01/2020 Last Posted : 10/28/2020

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Glazier	\$27.93	\$5.67	\$10.10	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$43.95	\$57.92
Apprentice	Percent											
1st 6 months	53.70	\$15.00	\$5.67	\$0.00	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$20.92	\$28.42
2nd 6 months	65.00	\$18.15	\$5.67	\$6.19	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$30.26	\$39.34
3rd 6 months	70.00	\$19.55	\$5.67	\$6.71	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$32.18	\$41.96
4th 6 months	75.00	\$20.95	\$5.67	\$6.85	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$33.72	\$44.19
5th 6 months	80.00	\$22.34	\$5.67	\$7.43	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35.69	\$46.87
6th 6 months	85.00	\$23.74	\$5.67	\$7.57	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.23	\$49.10
7th 6 months	90.00	\$25.14	\$5.67	\$8.09	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.15	\$51.72
8th 6 months	95.00	\$26.53	\$5.67	\$8.68	\$0.25	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.13	\$54.40

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

Each employer may employ and train Apprentices in the following ratio to journeymen workers employed.
1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, BROWN, BUTLER, CHAMPAIGN, CLARK, CLERMONT, CLINTON, DARKE, FAYETTE*, GREENE, HAMILTON, HIGHLAND, MIAMI, MONTGOMERY, PREBLE, SHELBY*, WARREN

Special Jurisdictional Note : Fayette County: Eastern portion of route #41 being the dividing line between locals 372 and 387. Local 387 has jurisdiction of projects built on property which borders route #41 East. Shelby County: Southern portion of routes #47 & 29.

Details :

Prevailing Wage Rate

Skilled Crafts

Name of Union: Ironworker Local 44

Change # : LCNO1-2021fbLoc44

Craft : Ironworker Effective Date : 06/24/2021 Last Posted : 06/24/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Ironworker Reinforcing	\$31.82		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.62	\$69.53
Structural	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Ornamental	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Machine Mover/Rigger	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Conveyer Mechanic	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Maintenance/Heavy Hwy	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Welder A	\$31.57		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.37	\$69.15
Welder B	\$31.82		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.62	\$69.53
Sheeter	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Fence Erector	\$29.75		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$51.55	\$66.42
Ironworker	\$31.32		\$8.50	\$9.50	\$0.60	\$0.00	\$3.00	\$0.20	\$0.00	\$0.00	\$53.12	\$68.78
Apprentice	Percent											
Apprentice												
1st yr A	60.00	\$19.09	\$8.50	\$9.50	\$0.60	\$0.00	\$0.75	\$0.20	\$0.00	\$0.00	\$38.64	\$48.19
1st yr B	65.00	\$20.68	\$8.50	\$9.50	\$0.60	\$0.00	\$0.75	\$0.20	\$0.00	\$0.00	\$40.23	\$50.57
2nd yr A	70.00	\$22.27	\$8.50	\$9.50	\$0.60	\$0.00	\$0.75	\$0.20	\$0.00	\$0.00	\$41.82	\$52.96
2nd yr B	75.00	\$23.87	\$8.50	\$9.50	\$0.60	\$0.00	\$0.75	\$0.20	\$0.00	\$0.00	\$43.42	\$55.35
3rd yr A	80.00	\$25.46	\$8.50	\$9.50	\$0.60	\$0.00	\$1.50	\$0.20	\$0.00	\$0.00	\$45.76	\$58.48
3rd yr B	85.00	\$27.05	\$8.50	\$9.50	\$0.60	\$0.00	\$1.50	\$0.20	\$0.00	\$0.00	\$47.35	\$60.87
4th yr A	90.00	\$28.64	\$8.50	\$9.50	\$0.60	\$0.00	\$2.25	\$0.20	\$0.00	\$0.00	\$49.69	\$64.01
4th yr B	95.00	\$30.23	\$8.50	\$9.50	\$0.60	\$0.00	\$2.25	\$0.20	\$0.00	\$0.00	\$51.28	\$66.39
4th yr C	100.00	\$31.82	\$8.50	\$9.50	\$0.60	\$0.00	\$2.25	\$0.20	\$0.00	\$0.00	\$52.87	\$68.78

Special Calculation Note : Other is Impact Fund Training

Ratio :

1 Journeymen to 1 Apprentice
 2 Journeymen to 2 Apprentices
 10 Journeymen to 4 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

ADAMS*, BROWN, BUTLER*, CLERMONT,
 CLINTON*, HAMILTON, HIGHLAND*,
 WARREN*

Special Jurisdictional Note : Adams County Twps included: Bratton, Scott, Winchester, Wayne. Butler County Twps included: Oxford, St. Clair, Fairfield, Morgan, Liberty, Union, Ross, Reily, Hanover. West Chester. In Clinton County, Manchester and South West Borrow. Highland County Twps included: Dotson, Salem, Clay, White Oak, Hamer, New Market, Concord, Jackson, Washington. Warren County Twps included: Harlan, Deerfield, Hamilton.

Details :

Structural Iron Work but not limited to:field fabrication, all loading to and including the erecting,rigging,assembly,dismantling, placing, temporary and permanent securing by any means of all structural iron,steel,ornamental lead,bronze,brass,copper,aluminum,glass all ferrous and non ferrous metal and composite material, precast prestressed and post-stressed concrete structures. Bridges and bridge rails,bridge viaducts,bucks bulkheads,bumper and bumper post,canopies and unistrut canopies,corrugated ferrous and non ferrous sheets when attached to steel frames,columns,beams,bar-joists,trusses,grinders,roof decking,electrical supports,elevator cars,elevator fronts and enclosures,erection of steel towers,flag poles, gymnasium equipment,stadium and arena seating,jail cell work,jail cell beds,benches,bunks,chairs,tables,mirrors,jail cell access doors,rigging and installation of machinery and equipment(erecting,aligning,anchoring and dismantling, erection and dismantling of tower cranes,derrick monorail systems, Chicago booms,overhead cranes,gantries,material and personnel hoists,tanks,hoppers and conveyors. All pre-engineered metal buildings and their entirety including siding,roofing, gutters, downspouts and erection of all.

Ornamental Iron Work but not limited to:all work in connection with field fabrication,handling including loading/off loading,sorting,cutting,fastening,anchoring,bending,hoisting,placing,burning,welding,and tying,dismantling of all materials used in miscellaneous iron or steel, for stairs,hand railings,rolling doors, rolling gates,rolling shutters,fence,windows,curtain wall,erection and welding of all metal, sash,architectural and ornamental treatments, but not necessarily limited to all sizes and types of ornamental,steel iron,lead,bronze,brass,copper,aluminum,all ferrous and non ferrous metals and composite materials

Fence Erector Iron Worker but not limited to: All work in connection with the field fabrication and erection of chain link fence,which includes but not limited to the loading and of the fence fabric and posts also the installation of the above.

Prevailing Wage Rate Skilled Crafts

Name of Union: Ironworker Local 290

Change # : LCN01-2021fbLoc290

Craft : Ironworker Effective Date : 01/27/2021 Last Posted : 01/27/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Ironworker Structural	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Welder	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Fence Erector	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Reinforcing Rods	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Machinery Mover	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Sheeter	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Metal Building Erector	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Rigger & Erector	\$29.68		\$8.30	\$9.50	\$0.65	\$0.00	\$4.45	\$0.02	\$0.00	\$0.00	\$52.60	\$67.44
Apprentice	Percent											
1st year	65.05	\$19.31	\$8.30	\$9.50	\$0.65	\$0.00	\$2.95	\$0.02	\$0.00	\$0.00	\$40.73	\$50.38
2nd year	75.07	\$22.28	\$8.30	\$9.50	\$0.65	\$0.00	\$2.95	\$0.02	\$0.00	\$0.00	\$43.70	\$54.84
3rd year	85.05	\$25.24	\$8.30	\$9.50	\$0.65	\$0.00	\$2.95	\$0.02	\$0.00	\$0.00	\$46.66	\$59.28
4th year	95.05	\$28.21	\$8.30	\$9.50	\$0.65	\$0.00	\$2.95	\$0.02	\$0.00	\$0.00	\$49.63	\$63.74

Special Calculation Note : Other is for Industry Fund.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ALLEN*, AUGLAIZE, BUTLER*, CHAMPAIGN*, CLARK, CLINTON, DARKE, FAYETTE*, GREENE, HARDIN*, HIGHLAND*, LOGAN*, MADISON*, MERCER*, MIAMI, MONTGOMERY, PREBLE, SHELBY, VAN WERT*, WARREN*

Special Jurisdictional Note : Allen County Twps included are: Auglaize, Perry, Shawnee, Amanda, Spencer, Marion, Sugar Creek, American, Bath, Jackson. Butler County Twps included are: Milford, Wayne, Madison, Lemon. Champaign Cnty Twps included are: Union, Urbana, Jackson, Concord, Salem, Mad River, Johnson, Harrison, Adams. Fayette County Twps included are: Green, Jasper, Concord, Jefferson. Hardin County Twps included are: Round Head, Marion,

Liberty. Highland County Twps included are: Fairfield, Penn, Union, Marshall, Liberty, Paint, Brush Creek. Logan County Twps included are: Richland, Stokes, Bloomfield, Washington, Harrison, McArthur, Lake, Liberty, Pleasant, Miami. Madison County Twps included are: Stokes. Mercer County Twps included are: Dublin, Washington, Jefferson, Recovery, Gibson, Union, Liberty, Butler, Granville, Center, Hopewell, Franklin, Marion. VanWert County Twps included are: Jennings. Warren County Twps included are: Franklin, Clear Creek, Turtle Creek, Wayne, Massie, Washington, Salem, Union.

Details :

Structural Iron Work but not limited to:field fabrication, all loading to and including the erecting,rigging,assembly,dismantling, placing, temporary and permanent securing by any means of all structural iron,steel,ornamental lead,bronze,brass,copper,aluminum,glass all ferrous and non ferrous metal and composite material, precast prestressed and post-stressed concrete structures. Bridges and bridge rails,bridge viaducts,bucks bulkheads,bumper and bumper post,canopies and unistrut canopies,corrugated ferrous and non ferrous sheets when attached to steel frames,columns,beams,bar-joists,trusses,grinders,roof decking,electrical supports,elevator cars,elevator fronts and enclosures,erection of steel towers,flag poles, gymnasium equipment,stadium and arena seating,jail cell work,jail cell beds,benches,bunks,chairs,tables,mirrors,jail cell access doors,rigging and installation of machinery and equipment(erecting,aligning,anchoring and dismantling, erection and dismantling of tower cranes,derrick monorail systems, Chicago booms,overhead cranes,gantries,material and personnel hoists,tanks,hoppers and conveyors. All pre-engineered metal buildings and their entirety including siding,roofing, gutters, downspouts and erection of all.

Ornamental Iron Work but not limited to:all work in connection with field fabrication,handling including loading/off loading,sorting,cutting,fastening,anchoring,bending,hoisting,placing,burning,welding,and tying,dismantling of all materials used in miscellaneous iron or steel, for stairs,hand railings,rolling doors, rolling gates,rolling shutters,fence,windows,curtain wall,erection and welding of all metal, sash,architectural and ornamental treatments, but not necessarily limited to all sizes and types of ornamental,steel iron,lead,bronze,brass,copper,aluminum,all ferrous and non ferrous metals and composite materials

Fence Erector Iron Worker but not limited to: All work in connection with the field fabrication and erection of chain link fence,which includes but not limited to the loading and of the fence fabric and posts also the installation of the above.

Prevailing Wage Rate Skilled Crafts

Name of Union: Labor HevHwy 3

Change # : LCN01-2021fbLocalHevHwy3

Craft : Laborer Group 1 Effective Date : 05/01/2021 Last Posted : 04/21/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Laborer Group 1	\$33.27		\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$45.22	\$61.86
Group 2	\$33.44		\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$45.39	\$62.11
Group 3	\$33.77		\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$45.72	\$62.61
Group 4	\$34.22		\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$46.17	\$63.28
Watch Person	\$26.00		\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$37.95	\$50.95
Apprentice	Percent											
0-1000 hrs	60.00	\$19.96	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$31.91	\$41.89
1001-2000 hrs	70.00	\$23.29	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$35.24	\$46.88
2001-3000 hrs	80.00	\$26.62	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$38.57	\$51.87
3001-4000 hrs	90.00	\$29.94	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.89	\$56.86
More than 4000 hrs	100.00	\$33.27	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$45.22	\$61.86

Special Calculation Note : Watchmen have no Apprentices. Tunnel Laborer rate with air-pressurized add \$1.00 to the above wage rate.

Ratio :

- 1 Journeymen to 1 Apprentice
- 3 Journeymen to 1 Apprentice thereafter

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SCIOTO, SENECA, SHELBY, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WYANDOT

Special Jurisdictional Note : Hod Carriers and Common Laborers - Heavy, Highway, Sewer, Waterworks, Utility, Airport, Railroad, Industrial and Building Site, Sewer Plant, Waste Water Treatment Facilities Construction

Details :

Group 1

Laborer (Construction); Plant Laborer or Yardman, Right-of-way Laborer, Landscape Laborer, Highway Lighting Worker, Signalization Worker, (Swimming) Pool Construction Laborer, Utility Man, *Bridge Man, Handyman, Joint Setter, Flagperson, Carpenter Helper, Waterproofing Laborer, Slurry Seal, Seal Coating, Surface Treatment or Road Mix Laborer, Riprap Laborer & Grouter, Asphalt Laborer, Dump Man (batch trucks), Guardrail & Fence Installer, Mesh Handler & Placer, Concrete Curing Applicator, Scaffold Erector, Sign Installer, Hazardous Waste (level D), Diver Helper, Zone Person and Traffic Control.

*Bridge Man will perform work as per the October 31, 1949, memorandum on concrete forms, by and between the United Brotherhood of Carpenters and Joiners of America and the Laborers' International Union of North America, which states in; "the moving, cleaning, oiling and carrying to the next point of erection, and the stripping of forms which are not to be re-used, and forms on all flat arch work shall be done by members of the Laborers' International Union of North America."

Group 2

Asphalt Raker, Screwman or Paver, Concrete Puddler, Kettle Man (pipeline), All Machine-Driven Tools (Gas, Electric, Air), Mason Tender, Brick Paver, Mortar Mixer, Skid Steer, Sheeting & Shoring Person, Surface Grinder Person, Screedperson, Water Blast, Hand Held Wand, Power Buggy or Power Wheelbarrow, Paint Striper, Plastic fusing Machine Operator, Rodding Machine Operator, Pug Mill Operator, Operator of All Vacuum Devices Wet or Dry, Handling of all Pumps 4 inches and under (gas, air or electric), Diver, Form Setter, Bottom Person, Welder Helper (pipeline), Concrete Saw Person, Cutting with Burning Torch, Pipe Layer, Hand Spiker (railroad), Underground Person (working in sewer and waterline, cleaning, repairing and reconditioning). Tunnel Laborer (without air), Caisson, Cofferdam (below 25 feet deep), Air Track and Wagon Drill, Sandblaster Nozzle Person, Hazardous Waste (level B), ***Lead Abatement, Hazardous Waste (level C)

***Includes the erecting of structures for the removal, including the encapsulation and containment of Lead abatement process.

Group 3

Blast and Powder Person, Muckers will be defined as shovel men working directly with the miners, Wrencher (mechanical joints & utility pipeline), Yarnier, Top Lander, Hazardous Waste (level A), Concrete Specialist, Curb Setter and Cutter, Grade Checker, Concrete Crew in Tunnels. Utility pipeline Tappers, Waterline, Caulker, Signal Person will receive the rate equal to the rate paid the Laborer classification for which the Laborer is signaling.

Group 4

Miner, Welder, Gunite Nozzle Person

A.) The Watchperson shall be responsible to patrol and maintain a safe traffic zone including but not limited to barrels, cones, signs, arrow boards, message boards etc.

The responsibility of a watchperson is to see that the equipment, job and office trailer etc. are secure.

Prevailing Wage Rate Skilled Crafts

Name of Union: Labor Local 534 Building

Change # : LCNO1-2021fbLoc534

Craft : Laborer Effective Date : 06/03/2021 Last Posted : 06/03/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Laborer Group 1	\$29.39	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.34	\$56.04	
Laborer Group 2	\$29.49	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.44	\$56.19	
Laborer Group 3	\$29.59	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.54	\$56.34	
Laborer Group 4	\$29.72	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.67	\$56.53	
Laborer Group 5	\$29.97	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.92	\$56.91	
Laborer Group 6	\$29.74	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.69	\$56.56	
Laborer Group 7	\$28.94	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$40.89	\$55.36	
Apprentice	Percent											
0-1000 hrs	60.00	\$17.63	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$29.58	\$38.40
1001-2000 hrs	70.00	\$20.57	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$32.52	\$42.81
2001-3000 hrs	80.00	\$23.51	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$35.46	\$47.22
3001-4000	90.00	\$26.45	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$38.40	\$51.63
4001	100.00	\$29.39	\$7.50	\$3.90	\$0.45	\$0.00	\$0.00	\$0.00	\$0.10	\$0.00	\$41.34	\$56.04

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeyman to 1 Apprentice
3 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BUTLER, WARREN

Special Jurisdictional Note :

Details :

Note:

Labor Local 534 Building

Group 1: Building & Common Laborer; All general laborers work including all forms of landscaping, Rough Rider - all pump's 4 inch or smaller, Small Pump Portable Generators-Bobcat to Cleanup, Firewatch and Monitor, (Safety Person)

Group 2: Asphalt Raker, Tamper, Smoother, Hand Air Pump, Hand air Tamper, Chisel, Power Tamper, Operator, Switch, Assemblies, Handling & Laying Precast Concrete Floors & Deck Tool Repairman.

Group 3: Concrete Specialist; Skid Steers (with attachments to perform Laborer's duties) Jack Hammer * Concrete Busterman, Barco Tamper Man, Power Georgia Buggy Man, Power Sweeper Man, Vibrator, Concrete Saw Man, Rail Spikers, Acetylene Burner, Pipelayers, Bos'n Cradleman, Bottom Man, Chipping Hammer Grade Checker, Radio Operator, Form Cleanout & blowout Man, Red Concrete Coloring Man (Electrical Safety)

Group 4: Mason Tender, Mortar Mixers & Scaffold Builders

Group 5: Fork Lift for Mason, all work involving Refractory Materials Including Demolition of Refractory Materials.

Asbestos Removal and Hazardous Waste Removal (handling, control, removal abatement, encapsulation or disposal of asbestos & hazardous waste),

Group 6: Gunnite Man, Sand Blaster, Concrete & Grout Pump & Hose Man, Blast Trac, Miners & Muckers, Free Air, Powderman or Blaster, Mortar or Gypsum Machineman, Welder, Scuba Diver.

Group 7: Watchman & Tool Checker/Toolroom Man

Prevailing Wage Rate Skilled Crafts

Name of Union: Operating Engineers - Building Local 18 - Zone III

Change # : LCN01-2021sksLoc18zone3

Craft : Operating Engineer Effective Date : 08/13/2021 Last Posted : 08/13/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Group A	\$39.14		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$55.09	\$74.66
Group B	\$39.02		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$54.97	\$74.48
Group C	\$37.98		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$53.93	\$72.92
Group D	\$36.80		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$52.75	\$71.15
Group E	\$31.34		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.29	\$62.96
Master Mechanic	\$39.39		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$55.34	\$75.03
Cranes 150'-180'	\$39.64		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$55.59	\$75.41
Cranes 180'-249'	\$40.14		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$56.09	\$76.16
Cranes 249' and over	\$40.39		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$56.34	\$76.53
Apprentice	Percent											
1st Year	50.00	\$19.57	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$35.52	\$45.31
2nd Year	60.00	\$23.48	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$39.43	\$51.18
3rd Year	70.00	\$27.40	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$43.35	\$57.05
4th Year	80.00	\$31.31	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.26	\$62.92
Field Mechanic Trainee			\$8.76	\$6.25	\$0.85			\$0.09				
1st Year	50.00	\$19.57	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$35.52	\$45.31
2nd Year	60.00	\$23.48	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$39.43	\$51.18
3rd Year	70.00	\$27.40	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$43.35	\$57.05
4th Year	80.00	\$31.31	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.26	\$62.92

Special Calculation Note : Other: Education & Safety \$0.09

Ratio :

For every (3) Operating Engineer Journeymen employed by the company there may be employed (1) Registered Apprentice or trainee Engineer through the referral when they are available. An apprentice, while employed as part of a crew per Article VIII, paragraph 78, will not be subject to the apprenticeship ratios in this collective bargaining agreement

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION,

Special Jurisdictional Note :

Details :

Note: There will be a 10% increase for the apprentices on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if required to have CDL

Group A- Barrier Moving Machines; Boiler Operators or Compressor Operators, when compressor or boiler is mounted on crane (Piggyback Operation); Boom Trucks (all types); Cableways Cherry Pickers; Combination - Concrete Mixers & Towers; All Concrete Pumps with Booms; Cranes (all types); Compact Cranes, track or rubber over 4,000 pounds capacity; Cranes self-erecting, stationary, track or truck (all configurations); Derricks (all types); Draglines; Dredges (dipper, clam or suction) 3-man crew; Elevating Graders or Euclid Loaders; Floating Equipment; Forklift (rough terrain with winch/hoist); Gradalls; Helicopter Operators, hoisting building materials; Helicopter Winch Operators, Hoisting building materials; Hoes (All types); Hoists (with two or more drums in use); Horizontal Directional Drill; Hydraulic Gantry (lift system); Laser Finishing Machines; Laser Screed and like equipment; Lift Slab or Panel Jack Operators; Locomotives (all types); Maintenance Operator/Technician(Mechanic Operator/Technician and/or Welder); Mixers, paving (multiple drum); Mobile Concrete Pumps, with booms; Panelboards, (all types on site); Pile Drivers; Power Shovels; Prentice Loader; Rail Tamper (with automatic lifting and aligning device); Rotary Drills (all), used on caissons for foundations and sub-structure; Side Booms; Slip Form Pavers; Straddle Carriers (Building Construction on site); Trench Machines (over 24" wide); Tug Boats.

Group B - Articulating/end dumps (minus \$4.00/hour from Group B rate); Asphalt Pavers; Bobcat-type and/or skid steer loader with hoe attachment greater than 7000 lbs.; Bulldozers; CMI type Equipment; Concrete Saw, Vermeer-type; Endloaders; Hydro Milling Machine; Kolman-type Loaders (Dirt Loading); Lead Greasemen; Mucking Machines; Pettibone-Rail Equipment; Power Graders; Power Scoops; Power Scrapers; Push Cats; Rotomills (all), grinders and planers of all types.

Group C - A-Frames; Air Compressors, Pressurizing Shafts or Tunnels; All Asphalt Rollers; Bobcat-type and/or Skid Steer Loader with or without attachments; Boilers (15 lbs. pressure and over); All Concrete Pumps (without booms with 5 inch system); Fork Lifts (except masonry); Highway Drills - all types (with integral power); Hoists (with one drum); House Elevators (except those automatic call button controlled), Buck Hoists, Transport Platforms, Construction Elevators; Hydro Vac/Excavator (when a second person is needed, the rate of pay will be "Class E"); Man Lifts; Material hoist/elevators; Mud Jacks; Pressure Grouting; Pump Operators (installing or operating Well Points or other types of Dewatering Systems); Pumps (4 inches and over discharge); Railroad Tie (Inserter/Remover); Rotovator (Lime-Soil Stabilizer); Submersible Pumps (4"and over discharge); Switch & Tie Tampers (without lifting and aligning device); Trench Machines (24" and under); Utility Operators.

Group D - Backfillers and Tampers; Ballast Re-locator; Batch Plant Operators; Bar and Joint Installing Machines; Bull Floats; Burlap and Curing Machines; Clefplanes; Compressors, on building construction; Concrete Mixers, more than one bag capacity; Concrete Mixers, one bag capacity (side loaders); All Concrete Pumps (without boom with 4" or smaller system); Concrete Spreader; Conveyors, used for handling building materials; Crushers; Deckhands; Drum Fireman (in asphalt plants); Farm type tractors pulling attachments; Finishing Machines; Form Trenchers; Generators: Gunitite Machines; Hydro-seeders; Pavement Breakers (hydraulic or cable); Post Drivers; Post Hole Diggers; Pressure Pumps (over 1/2") discharge); Road Widening Trenchers; Rollers (except asphalt); Self-propelled sub-graders; Shotcrete Machines; Tire Repairmen; Tractors, pulling sheepsfoot post roller or grader; VAC/ALLS; Vibratory Compactors, with integral power; Welders.

Group E – Allen Screed Paver (concrete); Boilers (less than 15 lbs. pressure); Cranes-Compact, track or rubber (under 4,000 pounds capacity); Directional Drill "Locator"; Fueling and greasing +\$3.00; Inboard/outboard Motor Boat Launches; Light Plant Operators; Masonry Fork Lifts; Oilers/Helpers; Power Driven Heaters (oil fired); Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalperson, Submersible Pumps (under 4" discharge).

Master Mechanics - Master Mechanic

Cranes 150' – 180' - Boom & Jib 150 - 180 feet

Cranes 180' – 249' - Boom & Jib 180 - 249 feet

Cranes 250' and over - Boom & Jib 250-feet or over

Prevailing Wage Rate Skilled Crafts

Name of Union: Operating Engineers - HevHwy Zone II

Change # : LCN01-2021sksLoc18hevhwyl

Craft : Operating Engineer Effective Date : 08/13/2021 Last Posted : 08/13/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Class A	\$39.14		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$55.09	\$74.66
Class B	\$39.02		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$54.97	\$74.48
Class C	\$37.98		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$53.93	\$72.92
Class D	\$36.80		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$52.75	\$71.15
Class E	\$31.34		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.29	\$62.96
Master Mechanic	\$39.39		\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$55.34	\$75.03
Apprentice Percent												
1st Year	50.00	\$19.57	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$35.52	\$45.31
2nd Year	60.00	\$23.48	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$39.43	\$51.18
3rd Year	70.00	\$27.40	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$43.35	\$57.05
4th Year	80.00	\$31.31	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.26	\$62.92
Field Mech Trainee Class 2												
1st year	50.00	\$19.57	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$35.52	\$45.31
2nd year	60.00	\$23.48	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$39.43	\$51.18
3rd year	70.00	\$27.40	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$43.35	\$57.05
4th year	80.00	\$31.31	\$8.76	\$6.25	\$0.85	\$0.00	\$0.00	\$0.09	\$0.00	\$0.00	\$47.26	\$62.92

Special Calculation Note : Other: Education & Safety Fund is \$0.09 per hour.

Ratio :

For every (3) Operating Engineer Journeymen employed by the company, there may be employed (1) Registered Apprentice or Trainee Engineer through the referral when they are available. An Apprentice, while employed as part of a crew per Article VIII, paragraph 65 will not be subject to the apprenticeship ratios in this collective bargaining agreement

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA,

SHELBY, STARK, TUSCARAWAS, UNION, VAN
WERT, VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

**Apprentices will receive a 10% increase on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if they are required to have CDL.

Class A - Air Compressors on Steel Erection; Asphalt Plant Engineers (Cleveland District Only); Barrier Moving Machine; Boiler Operators, Compressor Operators, or Generators, when mounted on a rig; Boom Trucks (all types); Cableways; Cherry Pickers; Combination- Concrete Mixers & Towers; Concrete Plants (over 4 yd capacity); Concrete Pumps; Cranes (all types); Compact Cranes track or rubber over 4,000 pounds capacity; Cranes self-erecting stationary, track or truck; Derricks (all types); Draglines; Dredges dipper, clam or suction; Elevating Graders or Euclid Loaders; Floating Equipment (all types); Gradalls; Helicopter Crew (Operator- hoist or winch); Hoes (all types); Hoisting Engines; Hoisting Engines, on shaft or tunnel work; Hydraulic Gantry (lifting system); Industrial-type Tractors; Jet Engine Dryer (D8 or D9) diesel Tractors; Locomotives (standard gauge); Maintenance Operators/Technicians (class A); Mixers, paving (single or double drum); Mucking Machines; Multiple Scrapers; Piledriving Machines (all types); Power Shovels, Prentice Loader; Quad 9 (double pusher); Rail Tamper (with automatic lifting and aligning device); Refrigerating Machines (freezer operation); Rotary Drills, on caisson work; Rough Terrain Fork Lift with winch/hoist; Side Booms; Slip Form Pavers; Survey Crew Party Chiefs; Tower Derricks; Tree Shredders; Trench Machines (over 24" wide); Truck Mounted Concrete Pumps; Tug Boats; Tunnel Machines and /or Mining Machines; Wheel Excavators.

Class B - Asphalt Pavers; Automatic Subgrade Machines, self-propelled (CMI-type); Bobcat-type and /or Skid Steer Loader with hoe attachment greater than 7000 lbs.; Boring Machine Operators (more than 48 inches); Bulldozers; Concrete Saws, Vermeer type; Endloaders; Horizontal Directional Drill (50,000 ft. lbs. thrust and over); Hydro Milling Machine; Kolman-type Loaders (production type-dirt); Lead Greasemen; Lighting and Traffic Signal Installation Equipment includes all groups or classifications; Maintenance Operators/Technicians, Class B; Material Transfer Equipment (shuttle buggy) Asphalt; Pettibone-Rail Equipment; Power Graders; Power Scrapers; Push Cats; Rotomills (all), Grinders and Planners of all types, Groovers (excluding walk-behinds); Trench Machines (24 inch wide and under).

Class C - A-Frames; Air Compressors, on tunnel work (low Pressure); Articulating/straight bed end dumps if assigned (minus \$4.00 per hour); Asphalt Plant Engineers (Portage and Summit Counties only); Bobcat-type and/or skid steer loader with or without attachments; Drones; Highway Drills (all types); HydroVac/Excavator (when a second person is needed, the rate of pay will be "Class E"); Locomotives (narrow gauge); Material Hoist/Elevators; Mixers, concrete (more than one bag capacity); Mixers, one bag capacity (side loader); Power Boilers (over 15 lbs. pressure); Pump Operators (installing or operating well Points); Pumps (4 inch and over discharge); Railroad Tie Inserter/Remover; Rollers, Asphalt; Rotovator (lime-soil Stabilizer); Switch & Tie Tampers (without lifting and aligning device); Utilities Operators, (small equipment); Welding Machines and Generators.

Class D – Backfillers and Tampers; Ballast Re-locator; Bar and Joint Installing Machines; Batch Plant Operators; Boring Machine Operators (48 inch or less); Bull Floats; Burlap and Curing Machines; Concrete Plants (capacity 4 yds. and under); Concrete Saws (multiple); Conveyors (highway); Crushers; Deckhands; Farm type tractors, with attachments (highway); Finishing Machines; Firemen, Floating Equipment (all types); Fork Lifts (highway), except masonry; Form Trenchers; Hydro Hammers; Hydro Seeders; Pavement Breakers (hydraulic or cable); Plant Mixers; Post Drivers; Post Hole Diggers; Power Brush Burners; Power Form Handling Equipment; Road Widening Trenchers; Rollers (brick, grade, macadam); Self-Propelled Power Spreaders; Self-Propelled Sub-Graders; Steam Firemen; Survey Instrument men; Tractors, pulling sheepsfoot rollers or graders; Vibratory Compactors, with integral power.

Class E - Compressors (portable, Sewer, Heavy and Highway); Cranes-Compact, track or rubber under 4,000 pound capacity; Drum Firemen (asphalt plant); Fueling and greasing (Primary Operator with Specialized CDL Endorsement Add \$3.00/hr); Generators; Inboard-Outboard Motor Boat Launches; Masonry Fork Lifts; Oil Heaters (asphalt plant); Oilers/Helpers; Power Driven Heaters (oil fired); Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalperson; Survey Rodmen or Chairmen; Tire Repairmen; VAC/ALLS.

Master Mechanic - Master Mechanic

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Locals 123 & 238

Change # : LCR01-2021fbLoc123-238

Craft : Drywall Finisher Effective Date : 05/01/2021 Last Posted : 04/21/2021

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Painter Drywall Finisher	\$25.89	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.85	\$50.80
Tapers and Finishers	\$25.89	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.85	\$50.80
Apprentice											
1st Year	\$14.83	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$23.23	\$30.64
2nd Year	\$17.63	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$26.03	\$34.85
3rd Year	\$20.43	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$28.83	\$39.05
4th Year	\$21.84	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$30.24	\$41.16

Special Calculation Note : Apprentices shall be paid the proper % of the classification above.

Ratio :

1 Journeyman to 1 Apprentice per job

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, CLINTON, HAMILTON, WARREN

Special Jurisdictional Note :

Details :

Industrial Work paid as commercial work above for each class which includes, Industrial Plants, repair garages, processing plants, storage tanks, warehouses, skeletons structures, bridges unless highest point of clearance is 60 feet or more whether new or old construction offices and office buildings in industrial sites are at industrial rates. Heavy & Highway Bridges-Guard Rails- Light Poles. A hazardous steeplejack rate shall apply on radio towers, stacks, light towers, water towers, steeples, skeleton steel, and exterior industrial conveyors over 25 feet, where such items require steeplejack methods and the rate of pay shall be a \$1.00 per hour above the industrial rate. Steeplejack rate to apply to bridges where highest point of clearance is 60 feet.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Locals 123 & 238
Commercial & Industrial

Change # : LCR01-2021fbLoc123

Craft : Painter Effective Date : 05/01/2021 Last Posted : 04/21/2021

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Painter Brush Roll	\$25.89	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.85	\$50.80
Paper Hanger	\$25.89	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$37.85	\$50.80
Spray Painter	\$26.39	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.35	\$51.55
Sand Blaster Water Blaster	\$26.64	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.60	\$51.92
Elevated Tanks	\$26.89	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.85	\$52.30
Apprentice											
1st Year	\$14.82	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$23.22	\$30.63
2nd Year	\$17.63	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$26.03	\$34.85
3rd Year	\$20.43	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$28.83	\$39.05
4th Year	\$21.84	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$30.24	\$41.16

Special Calculation Note : Apprentices shall be paid the proper % of the classification above.

Ratio :

(1) Journeymen to (1) Apprentice per jobsite

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, CLINTON,
HAMILTON, WARREN

Special Jurisdictional Note :

Details :

Industrial Work paid as commercial work above for each class which includes, Industrial Plants, repair garages, processing plants, storage tanks, warehouses, skeletons structures, bridges unless highest point of clearance is 60 feet or more whether new or old construction offices and office buildings in industrial sites are at industrial rates. Heavy & Highway Bridges-Guard Rails- Light Poles. A hazardous steeplejack rate shall apply on radio towers, stacks, light towers, water towers, steeples, skeleton steel, and exterior industrial conveyors over 25 feet, where such items require steeplejack methods and the rate of pay shall be a \$1.00 per hour above the industrial rate. Steeplejack rate to apply to bridges where highest point of clearance is 60 feet.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Local 123 & 238 Hvy Hwy

Change # : LCR01-2021fbLoc123

Craft : Painter Effective Date : 05/01/2021 Last Posted : 04/21/2021

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Painter Bridge Class 1	\$36.28	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$48.24	\$66.38
Bridge Painter, Rigger, Containment Builder, Spot Blaster Class 2	\$29.28	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.24	\$55.88
Equipment Operator/Field Mechanic, Grit Reclamation, Paint Mixer, Traffic Control, Boat Person Class 3	\$29.28	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.24	\$55.88
Concrete Sealing, Concrete Blasting/Power Washing, Etc. Class 4	\$29.28	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.24	\$55.88
Quality Control/Quality Assurance, Traffic Safety, Competent Person Class 5	\$29.28	\$5.79	\$5.86	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.24	\$55.88
Apprentice											
1st Year	\$20.58	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$28.98	\$39.27
2nd Year	\$24.21	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$32.61	\$44.71
3rd Year	\$27.84	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$36.24	\$50.16
4th Year	\$29.65	\$5.79	\$2.30	\$0.31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$38.05	\$52.87

Special Calculation Note : Apprentices shall be paid proper % of the classification above..

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, CLINTON, HAMILTON, WARREN

Special Jurisdictional Note :

Details :

Industrial Work paid as commercial work above for each class which includes, Industrial Plants, repair garages, processing plants, storage tanks, warehouses, skeletons structures, bridges unless highest point of clearance is 60 feet or more whether new or old construction offices and office buildings in industrial sites are at industrial rates. Heavy & Highway Bridges-Guard Rails- Light Poles. A hazardous steeplejack rate shall apply on radio towers, stacks, light towers, water towers, steeples, skeleton steel, and exterior industrial conveyors over 25 feet, where such items require steeplejack methods and the rate of pay shall be a \$1.00 per hour above the industrial rate. Steeplejack rate to apply to bridges where highest point of clearance is 60 feet.

Class 1 – Abrasive blasting of any kind.

Class 2 – Bridge painting, coating application of any kind. All steel surface preparation other than abrasive blasting. All necessary rigging and containment building. All remedial/ spot blasting.

Class 3 – Tend to all equipment including but not limited to abrasive blasting, power washing, spray painting, forklifts, hoists, trucks, etc. Load and unload trucks, handle materials, man safety boats, handle traffic control, clean up/ vacuum abrasive blast materials and related tasks.

Class 4 – All aspects of concrete coating/ sealing including but not limited to preparation, containment, etc.

Class 5 – Verify and record that all work is completed according to job specifications. Assure that all health and safety standards are adhered to. Assure all traffic is safely handled.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Local 639

Change # : LCNO1-2015fbLoc639

Craft : Painter Effective Date : 06/10/2015 Last Posted : 06/10/2015

	BHR	Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification											
Painter Metal Finisher/Helpers											
Top Helper Class A	\$19.09	\$3.65	\$0.00	\$0.00	\$0.66	\$0.00	\$0.00	\$0.00	\$0.00	\$23.40	\$32.94
Top Helper Class B	\$19.09	\$3.65	\$0.65	\$0.00	\$1.03	\$0.00	\$0.37	\$0.00	\$0.00	\$24.79	\$34.33
Top Helper Class C	\$19.09	\$3.65	\$1.00	\$0.00	\$1.76	\$0.00	\$0.37	\$0.00	\$0.00	\$25.87	\$35.41
Helper Class A	\$14.69	\$3.65	\$0.00	\$0.00	\$0.51	\$0.00	\$0.00	\$0.00	\$0.00	\$18.85	\$26.19
Helper Class B	\$14.69	\$3.65	\$0.65	\$0.00	\$0.79	\$0.00	\$0.28	\$0.00	\$0.00	\$20.06	\$27.40
Helper Class C	\$14.69	\$3.65	\$1.00	\$0.00	\$1.64	\$0.00	\$0.28	\$0.00	\$0.00	\$21.26	\$28.60
New Hire 90 Days	\$11.00	\$3.65	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$14.65	\$20.15

Special Calculation Note : Other is Sick and Personal Time**Ratio** :**Jurisdiction (* denotes special jurisdictional note) :**

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Top Helper: Shall perform the responsibilities of a Helper and be responsible for the setup, break down, safety and quality of the company's product.

Helper : Shall be responsible for performing tasks in refinishing, compliance with safety procedures, setting up and breaking down job sites, scaffolding and swing stages and preparing surfaces for refinishing including but not limited to, masking and stripping and cleaning, oxidizing, polishing and scratch removal on various surfaces

Class A Workers: Less than 1 Year of Service.

Class B Workers: More than 1 and less than 8 Years of Service.

Class C Workers: More than 8 Years of Service.

Metal Polisher Scope of Work: Polishing, buffing, stripping, coloring, lacquering, spraying, cleaning and maintenance of ornamental and architectural metals, iron, bronze, nickel, aluminum and stainless steel and in metal specialty work, various stone finishes, stone specialty work and any other work pertaining to the finishing of metal, stones, woods, and any window washing/cleaning done in conjunction with this work, using chemicals, solvents, coatings and hand applied lacquer thinner, removing scratches from mirror finished metals, burnishing of bronze, statuary finishes on exterior and interior surfaces and the use of all tools required to perform such work, including but not limited to polishes, spray equipment and scaffolding.

Swing State Rate: All work on scaffold 4 sections or higher, including any boom lifts and swing stage scaffolds including the rigging and derigging of hanging/suspended swing stage systems and rappelling/bolson chair work, ADD \$1.50 per hour.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Local 639 Zone 2 Sign

Change # : LCN01-2016fbLoc639

Craft : Painter Effective Date : 08/03/2016 Last Posted : 08/03/2016

Classification	BHR	Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
		H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Painter Sign Journeyman Tech/Team Leader Class A	\$21.25	\$1.33	\$0.14	\$0.00	\$0.00	\$0.00	\$0.57	\$0.00	\$0.00	\$23.29	\$33.92
Painter Sign Journeyman Tech/Team Leader Class B	\$21.25	\$1.33	\$0.14	\$0.00	\$0.41	\$0.00	\$0.57	\$0.00	\$0.00	\$23.70	\$34.32
Painter Sign Journeyman Tech/Team Leader Class C	\$21.25	\$1.33	\$0.14	\$0.00	\$0.82	\$0.00	\$0.57	\$0.00	\$0.00	\$24.11	\$34.74
Painter Sign Journeyman Tech/Team Leader Class D	\$21.25	\$1.33	\$0.14	\$0.00	\$1.23	\$0.00	\$0.57	\$0.00	\$0.00	\$24.52	\$35.14
Sign Journeyman Class A	\$20.98	\$1.33	\$0.14	\$0.00	\$0.00	\$0.00	\$0.56	\$0.00	\$0.00	\$23.01	\$33.50
Sign Journeyman Class B	\$20.98	\$1.33	\$0.14	\$0.00	\$0.40	\$0.00	\$0.56	\$0.00	\$0.00	\$23.41	\$33.90
Sign Journeyman Class C	\$20.98	\$1.33	\$0.14	\$0.00	\$0.81	\$0.00	\$0.56	\$0.00	\$0.00	\$23.82	\$34.31
Sign Journeyman Class D	\$20.98	\$1.33	\$0.14	\$0.00	\$1.21	\$0.00	\$0.56	\$0.00	\$0.00	\$24.22	\$34.71
Tech Sign Fabrication/ Erector Class A	\$15.90	\$1.33	\$0.14	\$0.00	\$0.00	\$0.00	\$0.43	\$0.00	\$0.00	\$17.80	\$25.75
Tech Sign Fabrication/ Erector Class B	\$15.90	\$1.33	\$0.14	\$0.00	\$0.31	\$0.00	\$0.43	\$0.00	\$0.00	\$18.11	\$26.06

Painter Local 639 Zone 2 Sign

Tech Sign Fabrication/ Erector Class C	\$15.90	\$1.33	\$0.14	\$0.00	\$0.61	\$0.00	\$0.43	\$0.00	\$0.00	\$18.41	\$26.36
Tech Sign Fabrication/ Erector Class D	\$15.90	\$1.33	\$0.14	\$0.00	\$0.92	\$0.00	\$0.43	\$0.00	\$0.00	\$18.72	\$26.67

Special Calculation Note : Other is for paid holidays.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, AUGLAIZE, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GREENE, HAMILTON, HANCOCK, HARDIN, HENRY, HIGHLAND, HOLMES, HURON, JACKSON, KNOX, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MERCER, MIAMI, MONTGOMERY, MORROW, MUSKINGUM, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, WARREN, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

- Class A: less that 1 year.
- Class B: 1-3 years.
- Class C; 3-10 years.
- Class D: More than 10 years.

Prevailing Wage Rate Skilled Crafts

Name of Union: Plasterer Local 132 (Cincinnati)

Change # : LCN02-2021fbLoc132

Craft : Plasterer Effective Date : 07/14/2021 Last Posted : 07/14/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Plasterer	\$26.65		\$5.80	\$8.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$42.40	\$55.72
Apprentice	Percent											
1st 900 hours	70.00	\$18.65	\$5.80	\$0.00	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$26.15	\$35.48
2nd 900 hours	74.00	\$19.72	\$5.80	\$0.00	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$27.22	\$37.08
3rd 900 hours	78.00	\$20.79	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$35.54	\$45.93
4th 900 hours	82.00	\$21.85	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$36.60	\$47.53
5th 900 hours	86.00	\$22.92	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$37.67	\$49.13
6th 900 hours	90.00	\$23.98	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$38.74	\$50.73
7th 900 hours	94.00	\$25.05	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$39.80	\$52.33
8th 900 hours	98.00	\$26.12	\$5.80	\$7.25	\$0.70	\$0.00	\$1.00	\$0.00	\$0.00	\$0.00	\$40.87	\$53.93

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

- 1 Journeyman to 1 Apprentice
- 4 Journeyman to 2 Apprentice
- 7 Journeyman to 3 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, HAMILTON, HIGHLAND, WARREN

Special Jurisdictional Note :

Details :

Apprentice and Shop Hand Pension are \$1.00 less than Journeyman.

Prevailing Wage Rate Skilled Crafts

Name of Union: Plumber Pipefitter Local 392

Change # : LCR01-2022sksLoc392

Craft : Plumber/Pipefitter Effective Date : 02/16/2022 Last Posted : 02/16/2022

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Plumber Pipefitter	\$35.01		\$8.58	\$13.59	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$58.20	\$75.71
Plumber Helper	\$21.33		\$7.30	\$6.59	\$0.50	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$35.72	\$46.38
Apprentice	Percent											
1st yr	45.00	\$15.75	\$8.38	\$0.95	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$26.10	\$33.98
2nd yr	50.02	\$17.51	\$8.38	\$0.95	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$27.86	\$36.62
3rd yr	55.00	\$19.26	\$8.38	\$7.47	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$36.13	\$45.75
4th yr	60.00	\$21.01	\$8.38	\$7.47	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$37.88	\$48.38
5th yr	75.00	\$26.26	\$8.38	\$13.59	\$0.54	\$0.00	\$0.00	\$0.48	\$0.00	\$0.00	\$49.25	\$62.38

Special Calculation Note : OTHER IS: SUPPLEMENTAL UNEMPLOYMENT BENEFITS.

Ratio :

- 1 Journeymen to 1 Apprentice
- 4 Journeymen to 2 Apprentices
- 6 Journeymen to 3 Apprentices
- 10 Journeymen to 4 Apprentices
- 16 Journeymen to 5 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

BROWN, BUTLER, CLERMONT, HAMILTON, WARREN

When more than Sixteen (16) Journeymen are employed additional apprentices may be acquired at a ratio of one (1) apprentice to four (4) journeymen.

Special Jurisdictional Note :

Details :

Helpers shall be permitted to work on ONLY , Exterior Sewers, Concrete, Vitrified Clay or PVC Pipe and Digging and Backfilling for Piping Work. The ratio shall not exceed 2 helpers to 1 Journeymen when performing the scope of work listed above

Prevailing Wage Rate Skilled Crafts

Name of Union: Roofer Local 42

Change # : LCNO1-2021sksLoc42

Craft : Roofer Effective Date : 12/15/2021 Last Posted : 12/15/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Roofer	\$28.85		\$8.02	\$7.95	\$0.32	\$0.00	\$1.25	\$0.06	\$0.00	\$0.00	\$46.45	\$60.88
Tradesmen	\$23.08		\$8.02	\$6.36	\$0.00	\$0.00	\$1.25	\$0.03	\$0.00	\$0.00	\$38.74	\$50.28
Apprentice	Percent											
1st period	60.00	\$17.31	\$8.02	\$4.77	\$0.03	\$0.00	\$1.25	\$0.00	\$0.00	\$0.00	\$31.38	\$40.03
2nd period	70.00	\$20.19	\$8.02	\$5.56	\$0.03	\$0.00	\$1.25	\$0.00	\$0.00	\$0.00	\$35.06	\$45.15
3rd period	80.00	\$23.08	\$8.02	\$6.36	\$0.03	\$0.00	\$1.25	\$0.00	\$0.00	\$0.00	\$38.74	\$50.28

Special Calculation Note : Other is for Training Fund

Ratio :

Employer may employ 1 apprentice for every 2 journeymen in his employment.

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, BROWN, BUTLER, CLERMONT, HAMILTON, HIGHLAND, WARREN

Special Jurisdictional Note :

Details :

Any Tradesman Worker completing 2,000 hours in (2) years may move to Journeyman status by utilizing the Training Yard to improve their skills. Tradesman Workers will be tested at these yards to determine their competency for Journeyman status. Tradesman Workers must schedule and successfully complete the industry test battery in order to gain journeyman status.

Prevailing Wage Rate Skilled Crafts

Name of Union: Sheet Metal Local 24 (Dayton)

Change # : LCR01-2021fbLoc24(Day)

Craft : Sheet Metal Worker Effective Date : 07/14/2021 Last Posted : 07/14/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Sheet Metal Worker	\$29.30	\$9.00	\$15.00	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$54.15	\$68.80	
Apprentice	Percent											
Apprentice												
5th Year B	85.00	\$24.91	\$8.76	\$11.51	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$46.03	\$58.48	
5th Year A	80.00	\$23.44	\$8.68	\$10.35	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$43.32	\$55.04	
4th Year B	75.00	\$21.98	\$8.60	\$9.18	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$40.61	\$51.59	
4th Year A	70.00	\$20.51	\$8.52	\$8.03	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$37.91	\$48.17	
3rd year B	65.00	\$19.05	\$8.45	\$6.85	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$35.20	\$44.72	
3rd Year A	60.00	\$17.58	\$8.37	\$5.69	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$32.49	\$41.28	
2 Year B	57.52	\$16.85	\$8.33	\$5.11	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$31.14	\$39.57	
2 Year A	55.00	\$16.12	\$8.29	\$4.52	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$29.78	\$37.83	
Probationary 1 Year	52.50	\$15.38	\$8.25	\$3.95	\$0.85	\$0.00	\$0.00	\$0.00	\$0.00	\$28.43	\$36.12	

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeyman to 1 Apprentice then,
1 Apprentice for every 2 Journeymen thereafter

Jurisdiction (* denotes special jurisdictional note) :

ALLEN, AUGLAIZE, BUTLER, CHAMPAIGN,
CLARK, CLINTON, DARKE, GREENE, HARDIN,
LOGAN, MERCER, MIAMI, MONTGOMERY,
PREBLE, SHELBY, VAN WERT, WARREN,
WYANDOT

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Sprinkler Fitter Local 669

Change # : LCN01-2022sksLoc669

Craft : Sprinkler Fitter Effective Date : 01/05/2022 Last Posted : 01/05/2022

	BHR		Fringe Benefit Payments						Irrevocable Fund		Total PWR	Overtime Rate
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)	MISC (*)		
Classification												
Sprinkler Fitter	\$41.87		\$10.99	\$7.10	\$0.52	\$0.00	\$5.12	\$0.00	\$0.00	\$0.00	\$65.60	\$86.53
Apprentice Indentured after April 1, 2013	Percent											
CILASS 1	45.00	\$18.84	\$7.85	\$0.00	\$0.52	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$27.21	\$36.63
CLASS 2	50.02	\$20.94	\$7.85	\$0.00	\$0.52	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$29.31	\$39.79
CLASS 3	54.40	\$22.78	\$10.99	\$7.10	\$0.52	\$0.00	\$1.15	\$0.00	\$0.00	\$0.00	\$42.54	\$53.93
CLASS 4	59.40	\$24.87	\$10.99	\$7.10	\$0.52	\$0.00	\$1.15	\$0.00	\$0.00	\$0.00	\$44.63	\$57.07
CLASS 5	64.42	\$26.97	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$46.98	\$60.47
CLASS 6	69.41	\$29.06	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$49.07	\$63.60
CLASS 7	74.40	\$31.15	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$51.16	\$66.74
CLASS 8	79.42	\$33.25	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$53.26	\$69.89
CLASS 9	84.40	\$35.34	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$55.35	\$73.02
CLASS 10	89.40	\$37.43	\$10.99	\$7.10	\$0.52	\$0.00	\$1.40	\$0.00	\$0.00	\$0.00	\$57.44	\$76.16

Special Calculation Note :

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW,

MUSKINGUM, NOBLE, OTTAWA, PAULDING,
PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE,
PUTNAM, RICHLAND, ROSS, SANDUSKY,
SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Sprinkler Fitter work shall consist of the installation, dismantling, maintenance, repairs, adjustments, and corrections of all fire protection and fire control systems including the unloading, handling by hand, power equipment and installation of all piping or tubing, appurtenances and equipment pertaining thereto, including both overhead and underground water mains, fire hydrants and hydrant mains, standpipes and hose connections to sprinkler systems used in connection with sprinkler and alarm systems. Also all tanks and pumps connected thereto, also included shall be CO-2 and Cardox Systems, Dry Chemical Systems, Foam Systems and all other fire protection systems.

Prevailing Wage Rate Skilled Crafts

**Name of Union: Truck Driver Bldg & HevHwy Class 1
Locals 20,40,92,92b,100,175,284,438,377,637,908,957**

Change # : LCRO1-2021fbBldgHevHwy

Craft : Truck Driver Effective Date : 05/21/2021 Last Posted : 05/21/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Truck Driver CLASS 1 4 wheel service, dump, and batch trucks, Oil Distributor - Asphalt Distributor-Tandems	\$29.24		\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.44	\$60.06
Apprentice	Percent											
First 6 months	80.00	\$23.39	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.59	\$51.29
7-12 months	85.00	\$24.85	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.05	\$53.48
13-18 months	90.00	\$26.32	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$42.52	\$55.67
19-24 months	95.00	\$27.78	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$43.98	\$57.87
25-30 months	100.00	\$29.24	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.44	\$60.06

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN,

HARRISON, HENRY, HIGHLAND, HOCKING,
HOLMES, HURON, JACKSON, JEFFERSON,
KNOX, LAWRENCE, LICKING, LOGAN,
LORAIN, LUCAS, MADISON, MAHONING,
MARION, MEDINA, MEIGS, MERCER, MIAMI,
MONROE, MONTGOMERY, MORGAN,
MORROW, MUSKINGUM, NOBLE, OTTAWA,
PAULDING, PERRY, PICKAWAY, PIKE,
PORTAGE, PREBLE, PUTNAM, RICHLAND,
ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY,
STARK, SUMMIT, TRUMBULL, TUSCARAWAS,
UNION, VAN WERT, VINTON, WARREN,
WASHINGTON, WAYNE, WILLIAMS, WOOD,
WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive \$0.20 cents per hour above their Basic Hourly Rate.

Prevailing Wage Rate

Skilled Crafts

**Name of Union: Truck Driver Bldg & HevHwy Class 2
Locals 20,40,92,92b,100,175,284,438,377,637,908,957**

Change # : LCRO1-2021fbBldgHevHwy

Craft : Truck Driver Effective Date : 05/21/2021 Last Posted : 05/21/2021

	BHR		Fringe Benefit Payments					Irrevocable Fund		Total PWR	Overtime Rate	
			H&W	Pension	App Tr.	Vac.	Annuity	Other	LECET (*)			MISC (*)
Classification												
Truck Driver CLASS 2 Tractor Trailer-Semi Tractor Trucks-Pole Trailers-Ready Mix Trucks-Fuel Trucks-Asphalt-Oil Spray bar men- 5 Axle & Over -Belly Dumps-End Dumps-Articulated Dump Trucks-Low boys-Heavy duty Equipment (irrespective of load carried) when used exclusively for transportation-Truck Mechanics (when needed)	\$29.66		\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.86	\$60.69
Apprentice	Percent											
First 6 months	80.00	\$23.73	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.93	\$51.79
7-12 months	85.00	\$25.21	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$41.41	\$54.02
13-18 months	90.00	\$26.69	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$42.89	\$56.24
19-24 months	95.00	\$28.18	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$44.38	\$58.47
25-30 months	100.00	\$29.66	\$7.50	\$8.50	\$0.20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$45.86	\$60.69

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive \$0.20 cents per hour above their Basic Hourly Rate.

SECTION 00 70 20
PERMITS

Contractor shall keep a copy of all permits at the project site throughout the duration of the work.



Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

August 12, 2021

Warren County Board of
Commissioners
Attn: Kathryn Gilbert

406 Justice Drive
Lebanon, OH 45036

RE: Warren County Board of Commissioners
Permit-Long Term

Approval
Surface Water Permit to Install
Warren
DSWPT11426834

Subject: Sycamore Trails WWTP Project - Installation of influent screens, aeration tanks, secondary clarifiers, UV disinfection., Springboro
Plans Received on June 29, 2021
From: Strand Associates Inc - Columbus

Ladies and Gentlemen:

Enclosed is an approved Ohio EPA Permit to Install. This permit contains several conditions and restrictions; I urge you to read it carefully. A general condition of your permit states that issuance of the permit does not relieve you of the duty of complying with all applicable federal, state, and local laws, ordinances, and regulations. You are hereby notified that this action of the Director is final and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of \$70.00, made payable to "Treasurer State of Ohio", which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address: Environmental Review Appeals Commission, 30 East Broad Street, 4th Floor, Columbus, OH 43215. If you have any questions, please contact the Ohio EPA District Office.

Ohio EPA has developed a customer service survey to get feedback from regulated entities that have contacted Ohio EPA for regulatory assistance, or worked with the Agency to obtain a permit, license or other authorization. Ohio EPA's goal is to provide our customers with the best possible customer service, and your feedback is important to us in meeting this goal. Please take a few minutes to complete this survey and share your experience with us at <http://www.surveymonkey.com/s/ohioepacustomersurvey>. If you have any questions, please contact the Ohio EPA district office to which you submitted your application.

Sincerely,

A handwritten signature in black ink, appearing to read "Kevin J. Fowler".

Kevin J. Fowler, Supervisor
Permit Processing Unit, Division of Surface Water

KJF/bd

Enclosure

cc: Southwest District Office Strand Associates Inc Warren County Combined Health District

By:  Date: _____

Ohio Environmental Protection Agency

8/12/2021

Permit to Install

Application No: 1426834

Applicant Name: Warren County Board of Commissioners
Address: 406 Justice Drive
City: Lebanon
State Zip: OH 45036

Person to Contact: Kathryn Gilbert
Telephone: 513-695-1645

Description of Proposed Source: Sycamore Trails WWTP Project - Installation of influent screens, aeration tanks, secondary clarifiers, UV disinfection., Springboro, Warren

Issuance Date: August 12, 2021

Effective Date: August 12, 2021

The above named entity is hereby granted a permit to install for the above described source pursuant to Chapter 3745-42 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the above described source of environmental pollutants will operate in compliance with applicable state and federal laws and regulations. Issuance of this permit does not constitute expressed or implied assurance that, if constructed or modified in accordance with those plans and specifications, the above described source of pollutants will be granted the necessary operating permits. This permit is granted subject to the following conditions attached hereto.

Ohio Environmental Protection Agency



Laurie A. Stevenson
Director
P.O. Box 1049
50 West Town Street, Suite 700
Columbus, OH 43216-1049

This permit shall expire if construction has not been initiated by the applicant within eighteen months of the effective date of this permit. By accepting this permit, the applicant acknowledges that this eighteen month period shall not be considered or construed as extending or having any effect whatsoever on any compliance schedule or deadline set forth in any administrative or court order issued to or binding upon the permit applicant, and the applicant shall abide by such compliance schedules or deadlines to avoid the initiation of additional legal action by the Ohio EPA.

The director of the Ohio Environmental Protection Agency, or his authorized representatives, may enter upon the premises of the above named applicant during construction and operation at any reasonable time for the purpose of making inspections, conducting tests, examining records, or reports pertaining to the construction, modification, or installation of the above described source of environmental pollutants.

Issuance of this permit does not relieve you of the duty of complying with all applicable federal, state, and local laws, ordinances, and regulations.

Any well, well point, pit or other device installed for the purpose of lowering the ground water level to facilitate construction of this project shall be properly abandoned in accordance with the provisions of Section 3745-9-10 of the Ohio Administrative Code or in accordance with the provisions of this plan or as directed by the Director or his representative. For more information please contact: Division of Drinking and Ground Water - Lazarus Government Center, 50 West Town Street, Suite 700, Columbus, Ohio 43215 (614) 644-2752.

Any person installing any well, well point, pit or other device used for the purpose of removing ground water from an aquifer shall complete and file a Well Log and Drilling Report form with the Ohio Department of Natural Resources, Division of Water, within 30 days of the well completion in accordance with the Ohio Revised code Section 1521.01 and 1521.05. In addition, any such facility that has a capacity to withdraw waters of the state in an amount greater than 100,000 gallons per day from all sources shall be registered by the owner with the chief of the Division of Water, Ohio Department of Natural Resources, within three months after the facility is completed in accordance with Section 1521.16 of the Ohio Revised Code. For copies of the necessary well log, drilling report, or registration forms, please contact:

Ohio Department of Natural Resources
2045 Morse Road Bldg. E
Columbus, OH 43229-6693
(614) 265-6717

1. The Sycamore Trails wastewater disposal system shall be constructed in strict accordance with the plans and application approved by the director of the Ohio Environmental Protection Agency. There shall be no deviation from these plans without the prior express, written approval of the agency. Any deviations from these plans or the above conditions may lead to such sanctions and penalties as provided for under Ohio law. Approval of these plans and issuance of this permit does not constitute an assurance by the Ohio Environmental Protection Agency that the proposed facilities will operate in compliance with all Ohio laws and regulations. Additional facilities shall be installed upon orders of the Ohio Environmental Protection Agency if the proposed sources are inadequate or cannot meet applicable standards.

2. If the construction area for this project is one acre or more, or is part of a larger development that is one acre or more, the applicant must submit a Notice of Intent (NOI) for coverage under the general construction stormwater permit to Ohio EPA at least 21 days prior to the start of construction of this project.

3. For projects involving construction or placement of fill in a stream or wetland, the applicant shall contact the appropriate district of the U.S. Army Corps of Engineers for a determination regarding potential impacts to water of the state as well as the requirements for obtaining, if necessary, certification. The applicant shall acquire a Section 404 permit and 401 water quality certification, if needed, before impacting any waters of the state as part of this project.
4. The Warren County Board of County Commissioners shall be responsible for proper operation and maintenance of the wastewater disposal system.
5. The operation of the disposal system shall be under the responsible charge of a certified operator having the proper certificate issued under Chapter 3745-7-05 of the Ohio Administrative Code.
6. This permit to install applies only to the wastewater disposal system listed above. The installation of drinking water supplies, air contaminant sources, or solid waste disposal facilities will require the submittal of a separate application to the director.
7. Provisions shall be made for proper operation of the wastewater pumping facilities.
8. Project Description: This project consist of the new installation of influent screens, aeration tanks, secondary clarifiers, UV disinfection, post-aeration, RAS pumping station, electrical building and a sludge holding tank.
9. This permit applies to a wastewater disposal system designed to serve an average daily hydraulic flow of no more than 180,000 gallons per day.
10. Roof drains, foundation drains, and other clean water connections to the disposal system are prohibited.
11. No liquids, sludges, or toxic or hazardous substances other than those set forth in the approved permit shall be accepted for disposal without the prior written approval of the Ohio Environmental Protection Agency.
12. The applicant shall notify the Ohio Environmental Protection Agency if the applicant does not continue as the sole user of the sewage disposal system.
13. The issuance of this permit to install for the Sycamore Trails WWTP Project located in Clearcreek Township, Warren County, Ohio is based upon the detailed plans electronically submitted to the Ohio EPA, Division of Surface Water, Southwest District Office, signed by an Ohio licensed Professional Engineer and dated June 24, 2021 as depicted on the cover page of the detailed plans.
14. The Southwest District office of the Ohio Environmental Protection Agency shall be notified in writing as to (a) the construction starting date; (b) the construction completion date; and (c) the date the wastewater disposal system was placed into operation.
15. The permit to install is not an authorization to discharge pollutants to waters of the state. Pursuant to Chapter 6111 of the Ohio Revised Code, the applicant shall apply for a permit to discharge (NPDES) 180 days prior to any discharge of pollutants to waters of the state.

SECTION 00 70 30
STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

The Warren County Water and Sewer Department has adopted the Standard General Conditions of the Construction Contract prepared by the Engineers Joint Contract Documents Committee and issued and published jointly by the American Consulting Engineers Council, the National Society of Professional Engineers, and the American Society of Civil Engineers. This document, contained herein, shall be made part of the Contract and shall be used during the performance of the work, except as modified by the following SECTION 00 80 10 Supplemental Conditions

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

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The Associated General Contractors of America



Construction Specifications Institute

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National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314

American Council of Engineering Companies
1015 15th Street, N.W., Washington, DC 20005

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

TABLE OF CONTENTS

Page

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY.....	6
1.01 <i>Defined Terms</i>	6
1.02 <i>Terminology</i>	8
ARTICLE 2 - PRELIMINARY MATTERS	9
2.01 <i>Delivery of Bonds and Evidence of Insurance</i>	9
2.02 <i>Copies of Documents</i>	9
2.03 <i>Commencement of Contract Times; Notice to Proceed</i>	9
2.04 <i>Starting the Work</i>	9
2.05 <i>Before Starting Construction</i>	9
2.06 <i>Preconstruction Conference</i>	9
2.07 <i>Initial Acceptance of Schedules</i>	9
ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE	10
3.01 <i>Intent</i>	10
3.02 <i>Reference Standards</i>	10
3.03 <i>Reporting and Resolving Discrepancies</i>	10
3.04 <i>Amending and Supplementing Contract Documents</i>	11
3.05 <i>Reuse of Documents</i>	11
3.06 <i>Electronic Data</i>	11
ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS.....	11
4.01 <i>Availability of Lands</i>	11
4.02 <i>Subsurface and Physical Conditions</i>	12
4.03 <i>Differing Subsurface or Physical Conditions</i>	12
4.04 <i>Underground Facilities</i>	13
4.05 <i>Reference Points</i>	13
4.06 <i>Hazardous Environmental Condition at Site</i>	13
ARTICLE 5 - BONDS AND INSURANCE	14
5.01 <i>Performance, Payment, and Other Bonds</i>	14
5.02 <i>Licensed Sureties and Insurers</i>	15
5.03 <i>Certificates of Insurance</i>	15
5.04 <i>Contractor’s Liability Insurance</i>	15
5.05 <i>Owner’s Liability Insurance</i>	16
5.06 <i>Property Insurance</i>	16
5.07 <i>Waiver of Rights</i>	17
5.08 <i>Receipt and Application of Insurance Proceeds</i>	17
5.09 <i>Acceptance of Bonds and Insurance; Option to Replace</i>	17
5.10 <i>Partial Utilization, Acknowledgment of Property Insurer</i>	18
ARTICLE 6 - CONTRACTOR’S RESPONSIBILITIES.....	18
6.01 <i>Supervision and Superintendence</i>	18
6.02 <i>Labor; Working Hours</i>	18
6.03 <i>Services, Materials, and Equipment</i>	18
6.04 <i>Progress Schedule</i>	18
6.05 <i>Substitutes and “Or-Equals”</i>	19
6.06 <i>Concerning Subcontractors, Suppliers, and Others</i>	20
6.07 <i>Patent Fees and Royalties</i>	21
6.08 <i>Permits</i>	21
6.09 <i>Laws and Regulations</i>	21
6.10 <i>Taxes</i>	22
6.11 <i>Use of Site and Other Areas</i>	22
6.12 <i>Record Documents</i>	22
6.13 <i>Safety and Protection</i>	22
6.14 <i>Safety Representative</i>	23
6.15 <i>Hazard Communication Programs</i>	23

6.16	<i>Emergencies</i>	23
6.17	<i>Shop Drawings and Samples</i>	23
6.18	<i>Continuing the Work</i>	24
6.19	<i>Contractor's General Warranty and Guarantee</i>	24
6.20	<i>Indemnification</i>	24
6.21	<i>Delegation of Professional Design Services</i>	25
ARTICLE 7 - OTHER WORK AT THE SITE		25
7.01	<i>Related Work at Site</i>	25
7.02	<i>Coordination</i>	26
7.03	<i>Legal Relationships</i>	26
ARTICLE 8 - OWNER'S RESPONSIBILITIES		26
8.01	<i>Communications to Contractor</i>	26
8.02	<i>Replacement of Engineer</i>	26
8.03	<i>Furnish Data</i>	26
8.04	<i>Pay When Due</i>	26
8.05	<i>Lands and Easements; Reports and Tests</i>	26
8.06	<i>Insurance</i>	26
8.07	<i>Change Orders</i>	26
8.08	<i>Inspections, Tests, and Approvals</i>	26
8.09	<i>Limitations on Owner's Responsibilities</i>	27
8.10	<i>Undisclosed Hazardous Environmental Condition</i>	27
8.11	<i>Evidence of Financial Arrangements</i>	27
ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION.....		27
9.01	<i>Owner's Representative</i>	27
9.02	<i>Visits to Site</i>	27
9.03	<i>Project Representative</i>	27
9.04	<i>Authorized Variations in Work</i>	27
9.05	<i>Rejecting Defective Work</i>	27
9.06	<i>Shop Drawings, Change Orders and Payments</i>	28
9.07	<i>Determinations for Unit Price Work</i>	28
9.08	<i>Decisions on Requirements of Contract Documents and Acceptability of Work</i>	28
9.09	<i>Limitations on Engineer's Authority and Responsibilities</i>	28
ARTICLE 10 - CHANGES IN THE WORK; CLAIMS		28
10.01	<i>Authorized Changes in the Work</i>	28
10.02	<i>Unauthorized Changes in the Work</i>	29
10.03	<i>Execution of Change Orders</i>	29
10.04	<i>Notification to Surety</i>	29
10.05	<i>Claims</i>	29
ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK.....		30
11.01	<i>Cost of the Work</i>	30
11.02	<i>Allowances</i>	31
11.03	<i>Unit Price Work</i>	31
ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES		32
12.01	<i>Change of Contract Price</i>	32
12.02	<i>Change of Contract Times</i>	33
12.03	<i>Delays</i>	33
ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK.....		33
13.01	<i>Notice of Defects</i>	33
13.02	<i>Access to Work</i>	33
13.03	<i>Tests and Inspections</i>	33
13.04	<i>Uncovering Work</i>	34
13.05	<i>Owner May Stop the Work</i>	34
13.06	<i>Correction or Removal of Defective Work</i>	34
13.07	<i>Correction Period</i>	34
13.08	<i>Acceptance of Defective Work</i>	35
13.09	<i>Owner May Correct Defective Work</i>	35
ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION		36
14.01	<i>Schedule of Values</i>	36
14.02	<i>Progress Payments</i>	36
14.03	<i>Contractor's Warranty of Title</i>	37
14.04	<i>Substantial Completion</i>	37

14.05	<i>Partial Utilization</i>	38
14.06	<i>Final Inspection</i>	38
14.07	<i>Final Payment</i>	38
14.08	<i>Final Completion Delayed</i>	39
14.09	<i>Waiver of Claims</i>	39
ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION		39
15.01	<i>Owner May Suspend Work</i>	39
15.02	<i>Owner May Terminate for Cause</i>	39
15.03	<i>Owner May Terminate For Convenience</i>	40
15.04	<i>Contractor May Stop Work or Terminate</i>	40
ARTICLE 16 - DISPUTE RESOLUTION		41
16.01	<i>Methods and Procedures</i>	41
ARTICLE 17 - MISCELLANEOUS		41
17.01	<i>Giving Notice</i>	41
17.02	<i>Computation of Times</i>	41
17.03	<i>Cumulative Remedies</i>	41
17.04	<i>Survival of Obligations</i>	41
17.05	<i>Controlling Law</i>	41
17.06	<i>Headings</i>	41

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*--The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*--The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*--A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*-- Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*--The individual or entity named as such in the Agreement.

20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does

not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and

duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *Schedule of Values*--A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site*--Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *Specifications*--That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

44. *Subcontractor*--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

45. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

49. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *Work*--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by

Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.

B. Intent of Certain Terms or Adjectives

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered", "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. Day

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. Defective

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents, or

b. does not meet the requirements of any applicable inspection, reference standard, test, or

approval referred to in the Contract Documents, or

c. has been damaged prior to Engineer's - recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which

Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other

submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

- a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or
- b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;
2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or
3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or

2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor

may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and
2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
- b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 Hazardous Environmental Condition at Site

A. Reports and Drawings: Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. Limited Reliance by Contractor on Technical Data

Authorized: Contractor may rely upon the general accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice:

(i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner’s own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence

of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclu-

sion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, (other than caused by flood) and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and

any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and,

in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make

settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques,

sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. "*Or-Equal*" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

- b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
- 3) will identify:
- a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services;
- 4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. Special Guarantee: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute

item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. Contractor's Expense: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

- 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor

2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or

royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on

entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 Taxes

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. Removal of Debris During Performance of the Work:

During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the

Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 Record Documents

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 Safety and Protection

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or

indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples*: Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the

requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to

revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
2. recommendation by Engineer or payment by Owner of any progress or final payment;
3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
6. any inspection, test, or approval by others; or
7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures.

Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and
2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
2. the specific matters to be covered by such authority and responsibility will be itemized; and
3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and

disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to

check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the

Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,
2. approve the Claim, or
3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All

cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone

directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. Costs Excluded: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. Contractor's Fee: When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

ARTICLE 12 - CHANGE OF CONTRACT PRICE;
CHANGE OF CONTRACT TIMES

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
2. there is no corresponding adjustment with respect any other item of Work; and
3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier

Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections,

tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and
3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or
2. correct such defective Work; or
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to

an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment,

including final payment, will impose responsibility on Engineer:

- a. to supervise, direct, or control the Work, or
- b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
- c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
- d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
- e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Change Orders;
- c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
- d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

- a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
- b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
- c. there are other items entitling Owner to a set-off against the amount recommended; or
- d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue

a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

- a. all documentation called for in the Contract Documents, including but not limited to the

evidence of insurance required by Paragraph 5.04.B.7;

- b. consent of the surety, if any, to final payment;
- c. a list of all Claims against Owner that Contractor believes are unsettled; and
- d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
3. Contractor's disregard of the authority of Engineer; or
4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),
2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and
3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment

within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or
2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

**SECTION 00 80 10
SUPPLEMENTAL CONDITIONS**

PART 1 GENERAL

1.1 GENERAL

- A. These Supplementary Conditions shall modify and supplement the Standard General Conditions of the Construction Contract (Section 00 70 30, EJCDC C-700), and shall govern whenever they conflict. All provisions which are not so amended or supplemented remain in full force and effect.

1.2 MODIFICATIONS TO ARTICLES OF THE GENERAL CONDITIONS

A. ARTICLE 1 – DEFINITIONS

1. Paragraph 1.01 A. 17 Add the following at the end of Paragraph A.17

“The following drawings are part of the Contract Documents”

Drawings Titled “Sycamore Trails Wastewater Treatment Plant Upgrades”, Contract No. 1-2021, Warren County Board of Commissioners. Sheets No. 1 - 53, prepared by Strand Associates, Inc. Electronic files were provided for the convenience of CONTRACTOR. The data on which the CONTRACTOR may rely is limited to the paper copy.

2. Paragraph 1.01.A.19 is supplemented with the following: Strand Associates, Inc. is the Engineer on the project.
3. Paragraph 1.01.A.29 is supplemented with the following: Whenever the term “Owner” is used in the Contract Documents, it shall refer to Warren County Board of Commissioners on behalf of Warren County Water & Sewer, or its authorized representative.

B. ARTICLE 2 – PRELIMINARY MATTERS

1. Paragraph 2.03 – Commencement of Contract Time: Notice to Proceed is amended as follows: Delete the last sentence.

C. ARTICLE 4 – AVAILABILITY OF LANDS; SURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

1. Paragraph 4.02(B) - add the following new paragraph(s) immediately after Paragraph 4.02(B):

C. In preparation of Drawings and Specifications, ENGINEER relied upon the following reports of explorations and tests of subsurface conditions at the Site:

1. Report dated June 9, 2020, prepared by Alt and Witzig Engineering, Inc.,

of West Chester, OH, entitled: Subsurface Investigations and Geotechnical Recommendations - Sycamore Trails Water Treatment Plant Upgrades - Wind Forest Drive, for Warren County, Ohio, consisting of 19 pages.

2. Report dated April 14, 2021, prepared by Alt and Witzig Engineering, Inc., of West Chester, OH, entitled: Subsurface Investigations and Geotechnical Recommendations - Sycamore Trails Water Treatment Plant Wall and Pond - Wind Forest Drive, for Warren County, Ohio, consisting of 14 pages.

The technical data in the above reports, upon which the CONTRACTOR may rely, consists of boring logs, test results, and boring locations all as of the date made. The “technical data” identified in the above reports is incorporated by reference into the contract documents.

ENGINEER accepts no responsibility for accuracy of the soil data or water level information. Soil information, included with these Contract Documents, was not obtained for the purposes of designing excavations and trenches. Soil information was used by ENGINEER for design purposes only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

D. In the preparation of Drawings and Specifications, ENGINEER relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities which are at or contiguous to the Site:

1. Drawings dated September 1978, prepared by Miami Engineering Co., of West Carrolton, OH, entitled: Sycamore Trails Wastewater Treatment Plant, for Warren County, Ohio, consisting of 17 sheets.

2. Drawings dated November 1993, prepared by National Wastewater Industries, of Cleves, OH, entitled: Sycamore Trails Sludge Holding Expansion, for Warren County, Ohio, consisting of 2 sheets.

3. Drawings dated September 1998, prepared by Environmental Engineering Service, of New Richmond, OH, entitled: Warren County Water and Sewer Department Sycamore Trails Wastewater Treatment Plant Upgrades, for Warren County, Ohio, consisting of 7 sheets numbered 1 to 7, inclusive.

None of the contents of such drawings include technical data on which CONTRACTOR may rely.

E. The Drawings listed above are not part of the Contract Documents and do not contain “Technical Data” upon which the Contractor may rely. Contractor is not entitled

to rely on other information and data known to or identified by OWNER and ENGINEER.

F. Copies of reports and drawings identified in SC-4.02.D that are not included with the Bidding Documents may be examined at Strand Associates, Inc, 615 Elsinore Place, Suite 320, Cincinnati, OH.

2. Paragraph 4.06(G) shall be deleted.

D. ARTICLE 5 – BONDS AND INSURANCE

1. Paragraph 5.01.A – Amend the second sentence to read: “ ...These bonds shall remain in effect not less than one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents”

2. Paragraph 5.01.D – Add the following paragraph:

“D. If the Contractor provided a certified or cashier’s check or letter of credit as Bid Security, he shall furnish a Performance Bond in an amount at least equal to 100% of the Contract Price as security for the faithful performance of this agreement.”

3. Paragraph 5.04.B.1 – Delete from the first sentence of Paragraph 5.04.B.1 of the General Conditions, the phrase “(subject to any customary exclusion regarding professional liability).”

4. Paragraph 5.04.B.1 – Add the following to the end of the Paragraph 5.04.B.1 of the General Conditions: “CONTRACTOR shall provide an executed endorsement form CG 20 01 04 13, or equal, supporting this requirement.”

5. Paragraphs 5.04.B.3 and 5.04.B.7 – Amend in Paragraphs 5.04.B.3 and 5.04.B.7 of the General Conditions the phrase “completed operations insurance” to read “products and completed operations insurance.”

6. Paragraph 5.04.B.5 – Delete the phrase “materially changed” in Paragraph 5.04.B.5 of the General Conditions and insert the following in its place: “materially changed with respect to coverage on the Project.”

7. Add the following new paragraphs immediately after 5.04.B:

“C. The Contractor shall, at his own expense, purchase and maintain the following minimum coverage:

1. Workers Compensation, for claims for bodily injury, sickness, disease or death as follows:

a. Coverage A Statutory Benefits as described by the applicable law.

b. Coverage B Employer’s Liability

i. \$500,000 Bodily Injury by Accident – each employee

ii. \$500,000 Bodily Injury by disease – each employee

iii. \$500,000 Bodily Injury by disease – policy limit

The Contractor shall provide a copy of a certificate of premium payment from the Industrial Commission and Bureau of Workers Compensation, State of Ohio, for the period of time specified during which construction commences and copies of renewal certificates for subsequent periods, so long as the project continues.

2. Comprehensive General Liability Coverage for Bodily Injury and Property Damage – occurrence form.

General Aggregate	\$2,000,000	Each occurrence, combined single limit for Bodily Injury and Property Damager
Products – Completed Operations	\$1,000,000	Each occurrence
Aggregate	\$2,000,000	
Personal and Advertising Liability per Occurrence	\$1,000,000	Combined Single Limit for Bodily Injury and Property Damager

Coverage shall be extended to include the following:

- a. Per project and per location aggregate.
- b. Premises and operations coverage.
- c. Coverage for liability and independent contractors.
- d. Products and completed operations.
- e. Coverage for explosion, collapse and underground hazards.
- f. Stop-Gap Liability: All monopolistic states - \$1,000,000.
- g. Broad Form Property Damage Coverage
- h. An elimination of the exclusions with respect to property under the care, custody, or control of CONTRACTOR. In lieu of elimination of the exclusion, CONTRACTOR may provide Builder’s Risk or Installation Floater coverage for property under the care, custody, or control of the CONTRACTOR.
- i. Explosion, Collapse, and Underground coverages where applicable under Property Damage Liability Insurance.
- j. Contractual Liability Coverage
- k. Independent Contractor Coverage.
- l. General Aggregate Limits specified above shall apply separately to this project by attachment of:

“Amendment of Limits of Insurance-Location(s) General Aggregate Limit Endorsement (ISO Form No. CG 25 04 05 09) or “Designated Construction Project(s) General Aggregate Limit” Endorsement (ISO Form CG 25 03 05 09) or equivalent endorsement coverage.

- m. 60-Day Notice of Cancellation or material change.

3. Comprehensive Automobile Liability Insurance – Occurrence Form

Any Automobile	\$1,000,000	Bodily Injury and Property Damage, Combined Single Limit
Borrowed, Non-Owned	\$1,000,000	Bodily Injury and Hired Automobile Property Damage, Combined Single Limit

Coverage shall be extended to include:

- a. Contractual liability for assumed liability.
- b. Owner and Engineer as additional insureds.
- c. Waiver of Subrogation against Owner and Engineer.
- d. 60 Day Notice of Cancellation or material change.
- e. Motor Carrier Act Endorsement MCS-90
- f. Extra Wide/Extra Heavy Hauling Permit Endorsement

4. Any Umbrella Liability or Excess Liability Policy over primary comprehensive General and Automobile Liability shall be carried in a minimum amount of:

\$5,000,000 Each Occurrence
 \$5,000,000 Aggregate

The Umbrella or Excess Policy shall be following the form of:

- a. Any Additional Insured under primary policy.
- b. Per project and per location aggregates.
- c. Explosion, Collapse, or Underground Hazards
- d. Stop-Gap Liability
- e. Waiver of Subrogation against Owner.
- f. Watercraft (when employed to perform the work).
- g. Aircraft (when employed to perform the work).
- h. 60-Day Notice of Cancellation or material change.

D. Insurance certificates for commercial general, automobile, umbrella, and builders risk shall specifically indicate by name the additional insureds which are to include OWNER and ENGINEER as well as other persons or entities so identified. Certificates shall be Acord 25-S or equivalent.

E. Additional Insured Endorsements

1. CONTRACTOR shall purchase and maintain liability insurance as described above, specifically naming as additional insureds OWNER and ENGINEER as well as other individuals or entities so identified (see the Supplementary Conditions), using Additional Insurance Endorsement Form CG 20 26 07 04, GC 20 10 07 04, or equivalent form. General liability policies shall also be endorsed with Form CG 20 37 07 04 to include the “products-completed

operations hazard.”

- F. Endorsements or General Liability policy shall not exclude supervisory or inspection services.

CONTRACTOR shall also provide an Additional Insured Endorsement for the automobile policy. Endorsement form shall be CA 20 48, or equal.

- G. Waiver of Subrogation: CONTRACTOR’s commercial general liability, automobile liability, umbrella or excess policies shall provide a waiver of subrogation covering OWNER and ENGINEER, and any individuals or entities identified in the Supplementary Conditions as additional insureds. CONTRACTOR shall obtain all necessary endorsements to support these requirements. Endorsement shall be CG 24 04 05 09, or equal.

- 8. Paragraph 5.06 – Change to provide that the CONTRACTOR shall obtain this policy.

- 9. Paragraph 5.06.A.2 – Delete and replace with the following:

“2. be written on a Builder’s Risk “all risk” policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and other such other perils or causes of loss.”

- 10. Paragraph 5.06 – Add new paragraph 5.06.A.8 as follows:

“8. The maintenance of specified insurance coverage is a material element of the contract and failure to maintain or renew insurance coverage or provide evidence of renewal may be treated as a material breach of the contract.”

- 11. Paragraph 5.06 – Add new paragraph 5.06.A.9 as follows:

“9. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with Paragraph 5.06.A shall comply with the requirements of Paragraph 5.06.C.”

- 12. Paragraph 5.06 – Add new paragraph 5.06.A.10 as follows:

“10. The CONTRACTOR shall obtain the appropriate amount of flood insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit. The Contractor shall take into consideration

the proximity of their work to rivers, drainage swales, work on or in proximity to storm sewer systems, unstable soils, work schedule, climate, the Contractor's means and methods, and any other considerations.”

13. Paragraph .06.B – Delete and replace with the following:

“B. Contractor shall be responsible for any deductible or self-insurance retention, and shall have those limits approved by OWNER, which approval shall not be unreasonably withheld.”

D. ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

1. Paragraph 6.01.A – After the first sentence add: “Contractor’s Work shall be performed according to the standards of care normally exercised by construction organizations within Ohio that are engaged in performing comparable services devoting such attention thereto and applying such skills as may be necessary to perform the work in accordance with the Contract Documents.”
2. Paragraph 6.02.C – Add a new paragraph as follows:
 - “C. If the Contractor does not perform the work in accordance with the Contractor’s construction schedule and the project construction schedule, and it becomes apparent that the work may not be completed within the contract times, the Contractor shall, at no additional cost to the Owner, as necessary to improve the Contractor’s progress: (a) increase the number of employees in such crafts as will regain lost scheduled progress; and (b) increase the number of working hours per shift, shifts per work day, working days per week, the amount of equipment, or any combination of the foregoing measures to regain lost scheduled progress. Contractor shall furnish such employees, materials, facilities, and equipment, and shall work such hours, including extra shifts, overtime operations, and Sundays and holidays, as may be necessary to insure the prosecution and completion of the work in accordance with the Contractor’s construction schedule and the project construction schedule.”
3. Paragraph 6.02.D – Add a new paragraph as follows:
 - “D. Contractor shall at all times maintain good discipline and order at the site. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them. If the Owner deems any employee of the Contractor or a subcontractor unsatisfactory, the Contractor must transfer or require its subcontractor to transfer such employee from the project immediately.”
4. Paragraph 6.05(E) - shall be deleted.

5. Paragraph 6.08 – Replace this Paragraph with the following:
 - “A. Permit requirements are specified in Section 00 20 00 – GENERAL INSTRUCTIONS TO BIDDERS, and 00 70 20 – PERMITS.

6. Paragraph 6.10 – Taxes, is amended as follows:
 - “A. OWNER, being a public body, is exempt from taxes on material incorporated into the work. CONTRACTOR, therefore, is not required to pay such materials taxes. The OWNER will provide the tax exemption forms. These forms are to contain all necessary information required by the State. CONTRACTOR shall be responsible for payment of any applicable commercial activity tax.

 - B. OWNER’s exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by CONTRACTOR, or to supplies or materials not incorporated to the Work.

 - C. CONTRACTOR is specifically required to abide by all local tax requirements, if any, including income tax requirements to withhold at source. CONTRACTOR acknowledges that the Contract work may take place in various cities and taxing districts, and further acknowledges different tax burdens may be imposed by each. CONTRACTOR shall indemnify, defend, and hold OWNER harmless for any federal, state, or local tax liabilities incurred as a result of CONTRACTOR performing the Work.”

6. Paragraphs 6.13 and 6.14 – Safety and Protection, are supplemented with the following: “All construction work under this Agreement is subject to Chapter XVII of Title 29, Code of Federal Regulations (CFR) Part 1926 (formerly Chapter XVII of Title 29, Part 1518) titled, “Safety and Health Regulations for Construction” and subsequent amendments.”

7. Paragraph 6.20 - Indemnification.

Add the following to the end of Paragraph 6.20 A of the General Conditions

C. In addition, CONTRACTOR shall indemnify, hold harmless, and pay for the defense of OWNER and ENGINEER from and against claims, losses, or damages in regard to any act or failure to act by OWNER or ENGINEER in connection with general supervision, inspection and/or coordination of CONTRACTOR’s operations.

CONTRACTOR shall, at its own expense, appear, defend, and pay all fees of attorneys and all costs and other expenses arising therefrom or incurred in connection therewith; and, if any judgments shall be rendered against any individual or entity indemnified hereunder in any such action, CONTRACTOR shall, at its own expense, satisfy and discharge same. CONTRACTOR expressly understands and agrees that any Letter of Credit or insurance protection required by the Contract, or otherwise provided by CONTRACTOR, shall in no way limit the responsibility to indemnify, keep and, save harmless, and

defend any individual or entity indemnified hereunder as herein provided.

Delete Paragraph 6.20.C.1 and 6.20.C.2. Insert new Paragraphs 6.20C.1 and D

1. the preparation of Drawings, Specifications, or Property Surveys

D. For any matter for which OWNER and ENGINEER are indemnified under Paragraph 6.20 A, CONTRACTOR shall pay for OWNER's and ENGINEER's reasonable defense, including, but not limited to, all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs or awards until OWNER or ENGINEER are found negligent. If OWNER or ENGINEER are found negligent, OWNER or ENGINEER shall reimburse CONTRACTOR for the prorata extent of OWNER's or ENGINEER's negligence for the cost of OWNER's or ENGINEER's reasonable defense.

E. ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

1. Paragraph 10.03.A.4 – Add the following paragraph:

“4. In no event is the Contractor entitled to reserve any rights or take other similar action with respect to a change order if the effect or intent of such reservation or action would be to accommodate a further adjustment in the contract times, contract price, or both, after the Contractor executes the change order. By executing a change order, the Contractor irrevocably certifies that the elements of the change order described are completely satisfied and waives all rights to seek further adjustment of the contract times, contract price, or both, at a later date with respect to the associated change in the work.”

E. ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

1. Paragraph 11.01(A)(3) – Amend the Second Sentence as follows: DELETE the phrase “If required by Owner”. Add Sentence OWNER requires CONTRACTOR to competitively bid work from subcontractors.

2. Paragraph 11.01(D) Add the following Sentence: This agreement shall be subject to open book pricing, CONTRACTOR shall make any all bids, invoices, receipts, any and all documentation for expenses and costs available for inspection by OWNER immediately upon request.

Paragraph 11.01.B.1 – Add project manager and project executive to the list of excluded compensation and payroll costs.

E. ARTICLE 12 – CHANGE OF CONTRACT PRICE, CHANGE OF CONTRACT TIMES

1. Paragraph 12.01.C.2.e – Add the following to the end of paragraph 12.01.C.2.e: “Any change that results in a net decrease in cost shall include the appropriate overhead and profit added thereto calculated as set forth in ARTICLE 12 of the

General Conditions.”

2. Paragraph 12.01.D – Insert new paragraph as follows: “D. In no event shall Contractor be entitled to any increase in the Contract Price on account of any adverse weather.”

3. Paragraph 12.02.B – Replace Paragraph 12.02.B with the following:

“B. If the Contractor wishes to make a claim for an increase in contract times, prompt written notice as provided herein shall be given. The Contractor’s claim shall include an estimate of cost and of probable effect of delay on progress of the work, a detailed schedule which identifies the critical portions of the work impacted by the delaying event and the dates of such impact, and a statement from Contractor that the increase requested is the entire increase in the contract time associated with the claim. The failure to provide such information and statement within the time period established in Paragraph 10.05.B shall constitute an irrevocable waiver of the claim. In the case of a continuing delay occurring on consecutive days, only one claim is necessary, provided, however, that within ten (10) days of the cessation of the cause of the continuing delay, the Contractor shall notify the Owner in writing that the cause of the delay has ceased. The failure to give notice of the cessation of the cause of the continuing delay shall constitute an irrevocable waiver of any claim based upon the continuing delay.”

4. Add the following paragraph as Paragraph 12.02.C:

“In addition to the requirements of Paragraph 12.02.B, if adverse weather conditions are the basis for a claim for additional time, the contractor shall support such claim with data acceptable to the Owner and Engineer that substantiates that weather conditions were significantly abnormal for the period of time and could not have reasonably been anticipated and that weather conditions had an adverse effect on a critical element of the scheduled construction. Notwithstanding any other provisions of the Contract Documents to the contrary, the project times will not be adjusted on account of the impact of an normal adverse weather or any of the work or on account of the impact of any abnormal adverse weather on non-critical elements of the work. The support for the of all adverse-weather claims resulting in lost work days shall be based upon criteria as provided for in the State of Ohio Department of Transportation (ODOT) Construction and Material Specifications dated January 1, 2013. ODOT Specification 108.06.C lists the number of days that the Contractor may expect to be lost due to weather as follows:

Month	Number of Days Lost Due to Weather
January	8
February	8

March	7
April	6
May	5
June	5
July	4
August	4
September	5
October	6
November	6
December	6

5. Paragraph 12.03.F – Add new paragraph as follows:

“F. Any proposed time extensions for delays requested because of abnormal weather conditions shall be subject to Paragraph 12.02.C.”

6. Paragraph 12.03.G. – Add new paragraph as follows:

“G. Delays beyond the substantial completion date attributable to and within the control of the Contractor, their Subcontractor, or Supplier shall be subject to liquidated damages in the amounts specified in SECTION 00 60 10 – CONTRACT.”

F. ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

1. Paragraph 15.01.A. – Delete the sentence that states: “Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

REPLACE the above sentence with the following: Contractor shall be granted an extension of the Contract Times directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

2. Paragraph 15.03.A(3) – shall be DELETED in its entirety.

G. ARTICLE 14 – PAYMENT TO CONTRACTOR AND COMPLETION

1. Add new Paragraph 14.02.A.4 as follows:

“4. In accordance with ORC Section 153.12 partial payments to the Contractor for labor performed under either a unit or lump sum price contract shall be made at the rate of ninety-two per cent of the estimates prepared by the Contractor and approved by the Engineer. All labor performed after the job is fifty percent completed shall be paid for at the rate of one hundred per cent of the estimates

submitted by the Contractor and approved by the Engineer. A Contract shall be considered 50 percent complete when the Contractor has been paid an amount equal to 50 percent of the total cost of the labor of the Contract and 50 percent of the total cost of the material of the Contract.

All materials furnished and delivered but not actually included in the construction and approved by the Owner, after the work under this contract is 50 percent complete, shall be paid for at the rate of 92 percent of the invoiced value of the materials. The balance of such estimates shall be paid when the material is incorporated into and becomes a part of the building construction.

When the major portion of the project is substantially completed and occupied, or in use, or otherwise accepted, and there exists no other reason to withhold retainage, the retained percentages held in connection with such portion shall be released and paid to the contractor, withholding only that amount necessary to assure completion.

All retained payments shall be deposited into an escrow account at the 1st National Bank, 1160 E. Main Street, Lebanon Ohio (513) 932-3221, Contact: Gail Haines. The Contractor may waive their right to deposit the payments in an escrow account by written request to the Owner. Retained payments not deposited into an escrow account will be held by the Owner for future payment to the Contractor.”

2. Amend Paragraph 14.02.C to read: “Thirty days after presentation

G. ARTICLE 16 – DISPUTE RESOLUTION

1. Delete Paragraphs 16.01.A, 16.01.B, and 16.01.C and replace with the following:

“1. This Contract shall be construed under the laws of the State of Ohio, and the parties hereby stipulate to the venue for any and all claims, disputes, interpretations, litigation of any kind arising out of this Contract being exclusively in the Warren County, Ohio Court of Common Pleas (unless both parties mutually agree in writing to alternate dispute resolution), as well as waiving any right to bring or remove such matters in or to any other state or federal court.”

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SPECIFICATIONS

SECTION 01 11 00

SUMMARY OF WORK

PART 1–GENERAL

1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract.

1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS–INTENT AND USE

- A. Intent of Documents:
 - 1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
 - 2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
 - 3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
 - 4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
 - 5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.
- B. Use of Documents:
 - 1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
 - 2. CONTRACTOR shall use all of the Project Drawings and Specifications:
 - a. For a complete understanding of the Project.
 - b. To determine the type of construction and systems required.
 - c. For coordination with other contractors.
 - d. To determine what other work may be involved in various parts or phases.
 - e. To anticipate and notify others when work by others will be required.
 - f. And all other relevant matters related to the project.

3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONSTRUCTION REQUIREMENTS

- A. In general, the following contract completion Milestones shall be followed. See Agreement for specific dates:
 1. Milestone 1 Completion: CONTRACTOR shall by that date, have completed and placed in service influent screens, aeration splitter, aeration tanks, MLSS tank, and electrical building.
 2. Milestone 2 Completion: CONTRACTOR shall by that date, have completed and placed in service final clarifiers, RAS/WAS pumping stations, drain pumping station.
 3. Substantial Completion: CONTRACTOR shall by that date, have the UV structure, post aeration tank, sludge holding tank, and final phase demolition substantially completed.
- B. General Information and Requirements:
 1. Currently, wastewater treatment at the Sycamore Trails Wastewater Treatment Plant influent screening, extended aeration activated sludge biological treatment, two clarifiers operated in series, tertiary treatment with sand filtration, chlorine tablet disinfection, and post aeration. Waste activated sludge is collected from two sets of clarifiers. The mechanical clarifiers and upflow clarifiers. There are two phases of clarification at this plant which run in a series. In order, the influent is clarified first by the mechanical clarifier, and then the upflow clarifier. Wasted sludge is stored in the sludge holding tank. The stored sludge is then removed and transported to a different wastewater treatment plant for treatment and disposal.
 2. Wastewater treatment during construction must be continuous and the treatment efficiency must be equal to that achieved prior to the start of construction.
 3. It shall be the responsibility of CONTRACTOR to not in any way impair the normal treatment or operating efficiency of the facilities, regardless of the work underway. No bypassing of raw or partially treated wastewater to receiving stream shall occur at any time as a result of construction. In general, this requires that new facilities be complete and ready for service or that temporary facilities be provided prior to removing existing units from service for modification or repair. CONTRACTOR shall provide all temporary piping, bypass pumping, and temporary construction required to complete the Work.
 4. Operation of existing treatment facilities will be the responsibility of OWNER. CONTRACTOR shall cooperate with OWNER's staff at all times. A minimum of 48 hours prior to making any process or electrical connections to existing facilities or modification or demolition of existing facilities, CONTRACTOR shall notify OWNER in writing. At the time of notification, CONTRACTOR shall submit a schedule for completion of the Work, including a description of measures that will be taken to minimize the impact to existing facilities.
 5. CONTRACTOR is responsible for draining all existing tanks and removing tank contents, including transfer of mixed liquor from existing aeration tanks to new aeration tanks. CONTRACTOR is responsible for all removal and disposal of sludge, grit, or other residue. CONTRACTOR is responsible for any pumping necessary for the Work. If there exists sludge, grit, or other residue that cannot be drained or pumped in its present state, it shall be the responsibility of the CONTRACTOR to remove and dispose of this material. OWNER will not be responsible for tank draining or cleaning required for the Work.

6. Access: CONTRACTOR shall maintain roadways open at all times to meet OWNER's requirements, including access for sludge hauling vehicles and chemical deliveries. CONTRACTOR shall be responsible for maintaining roadways in drivable condition, including placement of temporary stone and gravel and providing drainage as necessary. All city-owned roadways around the treatment facility shall be cleaned of construction site materials, soil, and debris as necessary.

C. Construction Sequence:

1. The following construction sequence is provided as a general guideline for the information and for the benefit of CONTRACTOR. This construction sequence is not intended to dictate means, method of construction, or direct construction activities. This construction sequence is a conceptual general construction sequence with minimum recommended outage, shutdowns, and operating units to be maintained in service. The general construction sequence is projected to allow the Work to be completed while maintaining treatment of the wastewater treatment plant. It is not intended to be all inclusive and does not list all work elements or details that are required to complete the Work, complete treatment processes, or place unit processes in service. CONTRACTOR shall be responsible for implementing any additional details required, including temporary piping, bypass pumping, or temporary construction at no additional cost to OWNER.
2. CONTRACTOR may propose alternate sequence or modifications to this sequence. OWNER will review the proposed modification and determine if such modification of the sequence interferes with the proper operation of the treatment activities. Any modifications to this general construction sequence shall be proposed in writing and shall be approved by OWNER prior to their implementations.
3. CONTRACTOR shall install erosion control measures.
4. CONTRACTOR shall install its temporary utilities and facilities. The proposed location of temporary facilities shall be approved by OWNER.
5. In general, new facilities shall be completed and placed into successful operation before the existing facilities are taken out of service.
6. Prior to equipment startup, mechanical equipment shall be checked by the manufacturer and written notice provided that the equipment is ready for startup.
7. CONTRACTOR shall coordinate with OWNER prior to removing equipment from service.
8. Disinfection must be in service from May 1st to October 31st with either the existing chlorine disinfection system or the proposed ultraviolet light disinfection system.
9. All existing clarifiers (Mechanical Clarifiers and Upflow Clarifiers) and Sand Filters must remain in service at all times until new Secondary Clarifiers (Structure 40) and RAS/WAS Pump Station and Valve Vault (Structure 50) are operational.
10. Work may begin on Disinfection and Post Aeration Structure (Structure 60) at any time but must be complete as part of Milestone 2.
11. Milestone 1 includes the demolition of the Sludge Drying Beds and the construction of the Influent Screening Station (Structure 10), the Aeration Tanks (Structure 20), the Electrical Building (Structure 30) and backup generator. Milestone 1 includes the construction of the proposed electrical service, blowers and aeration piping, and influent piping to the proposed Structure 10. It will likely be necessary to re-lay a portion of the existing influent sewer to the existing aeration tanks to accommodate the construction of Structure 20. CONTRACTOR shall be responsible for installing this pipe in a manner that allows continuous influent flow at the existing capacity to the existing aeration tanks during the Milestone 1 Construction. CONTRACTOR shall maintain OWNER's ability to continue the existing treatment processes during the construction of Milestone 1

- components. Piping is to be installed at MH-1 to connect to new influent screening structure. Temporary bypass pumping may be required and is to be provided by CONTRACTOR. See specification section Sewer Bypass Pumping- 33 01 31.
12. See Section 26 05 00 (General Electrical Requirements) for phasing of electrical service and temporary electrical service requirements.
 13. Plumbing system in Structure 30 (toilets, sinks, etc.) will not be operational until the completion of Milestone 2 because the Plant Drain Pumping Station is needed to take waste from the facility. Potable water connection to Structure 30 shall remain shutoff until the Plant Drain Pumping Station and Valve Vault (Structure 80) is in service.
 14. New influent screens must be in service before new aeration tanks are put in service. New aeration tanks may not be operated unless new influent screens are operational.
 15. It is likely that OWNER will operate one or two of the three proposed aeration tanks for forward flow biological treatment. New aeration tanks may be used as equalization basins or as a sludge holding tank. OWNER will be responsible for these operations during construction.
 16. New aeration tanks will be connected to the existing Mechanical Clarifiers to allow operation during construction of proposed Secondary Clarifiers (Structure 40). CONTRACTOR shall provide temporary piping from each side of the mixed liquor splitter section of the Aeration Tanks (Structure 20) to the individual existing Mechanical Clarifiers. Temporary piping shall be four inch diameter minimum and will require being buried. CONTRACTOR shall temporarily provide a total of four (4) submersible pumps to be installed in the hopper sections on the west side of the mechanical clarifiers to pump return activated sludge to the newly constructed Aeration Tank. Each pump shall have a capacity of approximately 25 gallons/minute. CONTRACTOR is responsible for providing temporary power as necessary from OWNER's electrical system. Pumps shall be submersible sewage ejector types capable of handling return sludge with solids concentrations of up to 10,000 mg/L. OWNER may waste sludge by hauling mixed liquor directly out of the aeration basins and taking for offsite disposal or may use an unused Aeration Tank for sludge storage. OWNER may elect to use an unused aeration tank for flow equalization. If this occurs, OWNER will be responsible for installing temporary pumping and piping necessary to accommodate this. Existing Upflow Clarifiers (downstream of existing Mechanical Clarifiers) shall remain in service. Return sludge discharge shall be rerouted to the influent of the Mechanical Clarifiers by CONTRACTOR.
 17. Milestone 2 involves the demolition of the Aeration Tanks, Sludge Holding Tank, Blower Building and existing electrical service and the construction of the Secondary Clarifiers (Structure 40), RAS Pumping Station (Structure 50), Disinfection and Post Aeration Structure (Structure 60) and Plant Drain Pumping Station (Structure 80). CONTRACTOR must provide OWNER 4 week notice before demolition is to begin on Sludge Holding Tank. Demolition of the existing Aeration Structure and Sludge Holding Tank may not begin until the new Influent Screening Station (Structure 10), Aeration Tank (Structure 20) and Electrical Building (Structure 30) are substantially complete and fully operational.
 18. A temporary connection to the outfall may be necessary once the Disinfection and Post Aeration Structure (Structure 60) is completed and ready to be placed in service and before the Surface Sand Filters and Chlorine Contact Tank are demolished. Any temporary piping shall have a capacity of 1.08 mgd and shall be provided by CONTRACTOR). Smaller temporary pipe may be used if CONTRACTOR provides detailed schedule for installation of permanent pipe and if said schedule is approved by OWNER.

19. Demolition of Mechanical Clarifier, Upflow Clarifiers, Surface Sand Filters and Chlorine Contact Tank may not begin until the Secondary Clarifiers (Structure 40), RAS Pumping Station (Structure 50), Disinfection and Post Aeration Structure (Structure 60), and Plant Drain Pumping Station (Structure 80) are substantially complete and in service.
20. Construction of Sludge Storage Tank (Structure 70) and Storage Building (Structure 90) may begin after demolition of Mechanical Clarifier, Upflow Clarifiers, Surface Sand Filters and Chlorine Contact Tank is complete.

1.05 CONTRACTOR USE OF SITE

A. General:

1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
2. Construction activities shall be confined within the "area of the site" limits.
3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER as shown on the Drawings.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER at locations shown on the Drawings.
4. Trees may not be cleared for parking, deliveries, or any other activities unless specified by OWNER. Construction limits shall be clearly marked and areas of the construction limits shall not be disturbed.

1.06 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
- C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
- D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.

- E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
- F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Existing Underground Utilities may consist of gas lines, water lines, storm sewers, and buried telephone and electric cables. The utilities shown on the drawings are based on data furnished by the utility companies.
- I. CONTRACTOR shall notify the Ohio Utilities Protection Service (OUPS), (811 or 1-800-362-2764), and any other non-OUPS/non-OGPUPS utility a minimum 48 hours prior to commencing work on the project to coordinate the marking of utilities in the field.
- J. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- K. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
- L. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.
- M. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- N. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required, the service or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- O. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.

- P. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing services and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional Work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

1.07 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.

1.08 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for use of other lands during construction. Copies of such agreements shall be provided to OWNER.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 29 00

CONTRACT CONSIDERATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Cash allowances.
 - 2. Inspection and Testing Allowances.
 - 3. Measurement and Payment–Lump Sum.

1.02 CASH ALLOWANCES

- A. See Paragraph 11.02 of the General Conditions for costs to be included in allowances.
- B. Refer to sections of the specifications identified in the Bid Form for specific information on use of cash allowances.
- C. The Bid shall include the amount equal to the specified quantity times the unit price.

1.03 INSPECTION AND TESTING ALLOWANCES

- A. Costs Included in Inspection and Testing Allowances: Cost of engaging an inspection or testing firm; execution of inspection and tests; and reporting results.
- B. Costs not to be included in Inspection and Testing Allowances but to be included in the Contract Price:
 - 1. Costs of incidental labor and facilities required to assist inspection or testing firm.
 - 2. Costs of testing laboratory services used by CONTRACTOR separate from Contract Document requirements.
 - 3. Costs of retesting upon failure of previous tests.
 - 4. Costs of tests specified to be provided by CONTRACTOR.
- C. Payment Procedures: Submit one copy of the inspection or testing firm's invoice with next application for payment.
- D. Refer to technical sections of specifications for required testing and any associated allowances.

1.04 MEASUREMENT AND PAYMENT–LUMP SUM

- A. Payment for Lump Sum projects will be based on the accepted schedule of values for the project.
- B. An acceptable schedule of values will include the following features:
 - 1. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during

- construction. Schedule shall be subdivided as necessary by specification section and work area.
2. Identify each line item with the number and title of the respective Specification Section.
 3. For each major line item list sub-values of major products or operations under the item.
 4. For the various portions of the work:
 - a. Each item shall include a directly proportional amount of CONTRACTOR's overhead and profit.
 - b. For items on which progress payments will be requested for stored materials, break down the value into:
 - (1) The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by ENGINEER.
 - (2) The total installed value.
 5. The sum of all values listed in the schedule shall equal the total Contract Sum.
 6. Schedule shall include a separate listing of general items such as bonds, insurance, mobilization, demobilization, field supervision, and record documents.
- C. Once a schedule of values is accepted, it shall not be revised, except for changes associated with subsequently executed change orders.
- D. No separate measurement for payment will be performed for Lump Sum Work.
- E. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- F. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- G. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.
- H. Some technical specification sections may include payment provisions. These provisions are in addition to the provisions of this section which apply to all of the Work.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 31 00

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Coordination.
 - 2. Field engineering.
 - 3. Progress meetings.
 - 4. Preinstallation meeting.

1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to provide an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01 11 00—Summary of Work for specific construction sequence.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and cleanup of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.

- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.
- C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.
- D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.
- E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- F. If existing property stakes not within the limits of the trench are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.
- G. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting.
- D. CONTRACTOR shall also provide the following information in written form at each meeting.
 - 1. Construction progress, including:
 - a. Activities completed this reporting period.
 - b. Activities in progress this reporting period.
 - c. Activities scheduled to commence this reporting period.
 - 2. Description of problem areas.
 - 3. Current and anticipated delays.
 - a. Cause of the delay.
 - b. Corrective action and schedule adjustments to correct the delay.
 - c. Impact of the delay on other activities, on milestones, and on completion dates.
 - 4. Changes in construction sequence.
- E. ENGINEER will prepare and distribute minutes to all attending parties.

1.05 PREINSTALLATION MEETING

- A. When required in individual specification sections, CONTRACTOR shall convene a preinstallation meeting at Work Site prior to commencing Work of the section.
- B. CONTRACTOR shall require attendance of parties directly affecting or affected by work of the specific section.
- C. CONTRACTOR shall notify ENGINEER 7 days in advance of meeting date.
- D. CONTRACTOR shall prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation, and installation procedures.
 - 2. Review coordination with related work.
- E. CONTRACTOR shall record minutes and distribute copies to participants within 2 days after meeting; two copies to ENGINEER, participants, and those affected by decisions made.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
 - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
 - 3. The type of submittal requirements specified in this section include construction progress schedule, submittal schedule, shop drawings, product data, samples, maintenance manuals, and other miscellaneous work-related submittals.
- B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to Article 7 of the General Conditions.
- C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to ENGINEER for review.

1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Name and location of project and identification number.
 - 3. Drawing number and specifications section number to which the submittal applies.
 - 4. Include the date of each submittal or resubmittal.

1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

1.05 CONSTRUCTION PROGRESS AND SUBMITTAL SCHEDULES

- A. Submit preliminary schedules within 10 days of the effective date of the Agreement.
- B. Revise schedules incorporating any comments provided at the schedule review conference required in GC.2.05 and resubmit.
- C. As a minimum, the construction progress schedule shall consist of a horizontal bar chart with a separate line for each major portion of Work or operation, identifying first workday of each week.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration for each activity. Identify activities that are on the critical path.
- E. Include line items for milestones (if any), Substantial, and Final Completion.
- F. Submit updated schedules with each Application for Payment, identifying changes since previous version.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.06 SHOP DRAWINGS

- A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 50% completion of the Work. Applications for payment beyond 50% of the Contract amount will not be recommended for payment until all shop drawings are submitted, including the required hard copies, or a revised schedule for any remaining submittals is agreed to by OWNER and ENGINEER.
- E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below. If electronic submittal is impossible, CONTRACTOR may request ENGINEER to review hard copy submittals on a limited basis. ENGINEER may request to review hard copy submittals on a limited basis for submittals that are over 100 pages in

length. If ENGINEER agrees to or requests hard copy submittal review, CONTRACTOR shall submit six color copies of shop drawings and descriptive data to ENGINEER for approval. Three copies of these will be returned to CONTRACTOR if approved. If shop drawings are not approved or if they are stamped "Approved as Noted-Resubmit," two corrected copies will be returned to CONTRACTOR for use in resubmittal. If CONTRACTOR desires more than three approved copies, submitted quantity shall be increased accordingly.

- F. Shop drawings submitted to ENGINEER will be reviewed and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit the above number of corrected shop drawings for all shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved" and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."
- G. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.
- H. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.
- I. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.
- J. Electronic Submittal Procedures:
 - 1. Summary:
 - a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format using Submittal Exchange, or equal, a website service designed specifically for transmitting submittals between construction team members, or equal.
 - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 - c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
 - 2. Procedures:
 - a. CONTRACTOR shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
 - b. CONTRACTOR shall transmit each submittal to ENGINEER using the Submittal Exchange website, www.submittalexchange.com, or equal.
 - c. ENGINEER review comments will be made available on the Submittal Exchange website for downloading. CONTRACTOR will receive email notice of completed review.
 - d. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
 - e. Electronically submitted shop drawings shall follow the following format:
 - (1) Filenames for the shop drawing submittals shall follow a XX XX XX.YYY-Z. Description convention where XX XX XX is the specification section number,

YYY is the submittal number, .Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with an -0 and the first resubmittal numbered with a -1.

- (a) Example file name: 03 20 00.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
 - (2) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by ENGINEER. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red. Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.
 - (3) Files shall be delivered without security features activated.
 - (4) Shop Drawings shall be uploaded as individual files. Files combined into a zip drive are not acceptable. All pages of one submittal should be contained in one file.
 - (5) The file shall open to a cover page containing, at a minimum, the following information:
 - (a) CONTRACTOR's stamp.
 - (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
 - (c) Project number.
 - (d) Submittal number.
 - (e) Submission date, if resubmittal, all previous submission dates.
 - (f) Index detailing contents and the total number of pages in the submittal.
- f. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide three hard color copies of the "Approved" or "Approved as Noted," shop drawings to ENGINEER. CONTRACTOR is responsible for the hard copy color replication of ENGINEER's "Approved" or "Approved as Noted," shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.
3. Costs:
- a. CONTRACTOR shall include the full cost of Submittal Exchange, or equal, project subscription in their proposal. This cost shall be included in the Contract amount. Contact Submittal Exchange at 1-800-714-0024 to verify cost prior to Bid.
 - b. At CONTRACTOR's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
 - c. Internet Service and Equipment Requirements:
 - (1) Email address and Internet access at CONTRACTOR's main office.
 - (2) Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.
- K. CONTRACTOR is fully responsible for obtaining any and all copyright permission associated with conversion of shop drawing information to electronic format.
- L. Shop drawings shall include verification that the item meets applicable codes and standards.

1.07 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

1.08 SAMPLES AND FIELD MOCKUPS

- A. CONTRACTOR shall provide samples and field mockups where noted or specified.
- B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.
- C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and full range of color, texture, and pattern.
- D. Samples shall have labels firmly attached, bearing the following information:
 - 1. Name of project.
 - 2. Description of product and finish.
 - 3. Name of CONTRACTOR.
 - 4. Trade name and number of product.
 - 5. Standards met by the product.
- E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.
- F. Samples, unless otherwise noted, become the property of OWNER.
- G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.
- H. Field Mockups:
 - 1. CONTRACTOR shall erect field mockups at the project site in a location acceptable to ENGINEER and OWNER.
 - 2. When accepted by ENGINEER, the mockup will become the basis for comparison of the actual work.
 - 3. Remove mockup at conclusion of the work if it was not incorporated into the work.

1.09 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.

- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

1.10 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by ENGINEER.
- B. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data and resubmit as specified for initial submittal.
 - 2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.
- C. Electronic shop drawing resubmissions shall follow the nomenclature described in Section 1.06.
- D. CONTRACTOR shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. ENGINEER will record ENGINEER's time for review subsequent submittals of shop drawings, samples, or other items required for approval and CONTRACTOR shall reimburse OWNER and ENGINEER's charges for such time.
- E. In the event that CONTRACTOR requests a substitution for previously approved item, CONTRACTOR shall reimburse OWNER for ENGINEER's charges for its review time unless the need for such change is beyond control of CONTRACTOR.

1.11 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

1.12 MAINTENANCE MANUAL

- A. Prior to 75% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to ENGINEER four complete copies of a maintenance manual for all equipment furnished. Applications for payment beyond 75% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and ENGINEER.

- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. All sheets shall have reduced dimensions as described for shop drawings, and shall be furnished in 3-ring binders or 3-tab report covers.
- D. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. The CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.
- E. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XX XX XX_YY.PDF) where XX XX XX is the specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.
- F. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.
- G. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by ENGINEER. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 6 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.
- H. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- I. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter", "Section", "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of ENGINEER. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate (to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed).
- J. Thumbnails shall be generated and embedded in each PDF file.

- K. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- L. The opening view for PDF files shall be set as follows:
 - 1. Initial View: Bookmarks and Page
 - 2. Magnification: Fit In Window
 - 3. Page Layout: Single Page
- M. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.
- N. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- O. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.
- P. Each maintenance manual shall include a completed equipment maintenance summary form for each type and size of equipment being furnished that requires power, lubrication, or maintenance. Equipment Summary forms are located at the end of this section.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

EQUIPMENT MAINTENANCE SUMMARY FORM⁽¹⁾

Equipment _____ No.: _____

Specification Section: _____
Equipment Name: _____
Building Name: _____ Room No.: _____
Plant Location: _____
Manufacturer: _____
Address: _____
Phone: _____
Service Representative: _____
Address: _____
Phone: _____ Fax: _____
Make: _____ Model: _____
Serial No.: _____ Type: _____
Size: _____
Equipment Speed: _____
Capacity: _____
Operating Range: _____
Material: _____
Alarms: _____

Drive Ratio: _____
Motor Speed: _____ Service Factor: _____
Volts: _____ Phase: _____ hp: _____ Efficiency: _____
Motor Type: _____
Motor Sensors: _____
Motor Manufacturer: _____
Model: _____ Motor Frame: _____
Insulation Class: _____ FLA: _____ LRA: _____

(1) Complete as applicable; attach supplementary pages as necessary.

Maintenance Requirements
(Use additional sheets if more space is needed.)

LUBRICATION

<u>Item</u>	<u>Generic Type of Lubricant</u>	<u>Supplier</u>	<u>Estimated Frequency</u>	<u>Annual Quantity</u>
-------------	--------------------------------------	-----------------	--------------------------------	----------------------------

PREVENTIVE MAINTENANCE

<u>Item</u>	<u>Action</u>	<u>Frequency</u>	<u>Reference</u>
-------------	---------------	------------------	------------------

SUGGESTED MINIMUM SPARE PARTS LIST

<u>Manufacturer</u>	<u>Part No.</u>	<u>Quantity</u>	<u>Unit</u>	<u>Description</u>
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The following information is included in O&M Manual:

Check or mark N/A

1. Recommended installation, adjustment, calibration, and troubleshooting. _____
2. Complete internal and connection wiring diagrams. _____
3. Complete parts lists, by generic title and identification number, with exploded views of each assembly. _____
4. Disassembly, overhaul, and reassembly instructions. _____
5. Recommended prestart checks. _____
6. Recommended start procedure. _____
7. Recommended shutdown procedure for both short and long term. _____
8. Recommended operating precautions that include safety for personnel and equipment. _____
9. Recommended standing maintenance procedure. _____

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. OSHA requirements.
 - 2. Roadway limits.
 - 3. Permits.
 - 4. Wage rates.

1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act."

1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

- A. The following permits were obtained by OWNER:
 - 1. Ohio EPA Permit to Construct (PTI).
 - 2. Commercial Building, Electrical and HVAC Permit (Warren County).
 - 3. Zoning Permit (Warren County).
 - 4. Earth Disturbing Permit (Warren County Soil and Water Conservation District).
- B. They are included as attachments to this division. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- C. A building permit will be required from OWNER. However, OWNER will waive fees associated with the permit.
- D. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.

1.05 WAGE RATES

- A. CONTRACTOR shall pay wages to each laborer and mechanic at a rate not less than the minimum wages specified in the current wage determination as published by the State of Ohio Department of Commerce. Current wage rates can be viewed on the State of Ohio Department of Commerce website.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS AND DEFINITIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Reference Standards:
 - a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
 - b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
 - c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
 - 2. Definitions:
 - a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
 - b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
 - c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.
- B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

1.02 QUALITY ASSURANCE

- A. Familiarity with Pertinent Codes and Standards:
 - 1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
 - 2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.
- B. Overlapping or Conflicting Requirements:
 - 1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.02 of the General Conditions for additional provisions regarding references.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA Aluminum Association
1525 Wilson Boulevard, Arlington, VA 22209
2. AAMA American Architectural Manufacturer's Association
1827 Walden Office Square Suite 550, Schaumburg, IL 60173-4268
3. AASHTO American Association of State Highway & Transportation Officials
444 North Capitol Street NW Suite 249, Washington, DC 20001
4. ACI American Concrete Institute
38800 Country Club Drive, Farmington Hills, MI 48331-3439
5. AI Asphalt Institute
2696 Research Park Drive, Lexington, KY 40511-8480
6. AISC American Institute of Steel Construction
One East Wacker Drive Suite 700, Chicago, IL 60601-1802
7. AISI American Iron and Steel Institute
25 Massachusetts Avenue NW Suite 800, Washington, DC 20001
8. ANSI American National Standards Institute
25 West 43rd Street, New York, NY 10036
9. APA American Plywood Association
7011 South 19th, Tacoma, WA 98466-5333

10. API American Petroleum Institute
1220 L Street NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute
4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering
901 Canterbury Suite A, Westlake, OH 44145
15. ASTM ASTM International
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute
46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA American Wood Protection Association
P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS American Welding Society
8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA American Water Works Association
6666 West Quincy Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association
355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA Brick Industry Association
1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI Concrete Reinforcing Steel Institute
9333 North Plum Grove Road, Schaumburg, IL 60173
23. DOT U.S. Department of Transportation
1200 New Jersey Avenue, SE, Washington, DC 205940
24. EJMA Expansion Joint Manufacturers Association
25 North Broadway, Tarrytown, NY 10591
25. FM FM Global
FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919

26. FTI Facing Tile Institute
Box 8880, Canton, OH 44711
27. GA Gypsum Association
6525 Belcrest Road Suite 480, Hyattsville, MD 20782
28. GANA Glass Association of North America
800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
29. ICC International Code Council
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
30. IES Illuminating Engineering Society
120 Wall Street, Floor 17, New York, NY 10005-4001
31. MIL Military Specifications
Naval Publications and Forms Center
5801 Tabor Avenue, Philadelphia, PA 19120
32. NAAMM National Association of Architectural Metal Manufacturers
800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
33. NCMA National Concrete Masonry Association
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
34. NECA NECA
National Electrical Contractors Association
3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
35. NEMA National Electrical Manufacturers Association
1300 North 17th Street Suite 1752, Rosslyn, VA 22209
36. NFPA National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02169-7471
37. NIST National Institute of Standards and Technology
(U.S. Department of Commerce), 100 Bureau Drive, Stop 1070
Gaithersburg, MD 20899-1070
38. NRCA National Roofing Contractors Association
10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
39. NSF National Sanitation Foundation International
P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
40. OSHA Occupational Safety & Health Administration
200 Constitution Avenue NW, Washington, DC 20210
41. PCA Portland Cement Association
5420 Old Orchard Road, Skokie, IL 60077

- 42. PCI Prestressed Concrete Institute
200 West Adams Street Suite 2100, Chicago, IL 60606
- 43. SAE Society of Automotive Engineers
SAE World Headquarters
400 Commonwealth Drive, Warrendale, PA 15096-0001
- 44. SDI Steel Deck Institute
P.O. Box 25, Fox River Grove, IL 60021
- 45. SDI Steel Door Institute
30200 Detroit Road, Westlake, OH 44145-1987
- 46. SIGMA Sealed Insulating Glass Manufacturers Assoc.
401 North Michigan Avenue Suite 2400, Chicago, IL 60611
- 47. SJI Steel Joist Institute
234 Cheves Street, Florence, SC 29501
- 48. SMACNA Sheet Metal and Air Conditioning
Contractor's National Association
4201 Lafayette Center Drive, Chantilly, VA 20151-1219
- 49. SSPC Society for Protective Coatings
40 24th Street 6th Floor, Pittsburgh, PA 15222-4656
- 50. TCA Tile Council of America
100 Clemson Research Boulevard, Anderson, SC 29625
- 51. UL Underwriters Laboratories
333 Pfingston Road; Northbrook, IL 60062

1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

1.05 DEFINITIONS

- A. Indicated:
 1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

- B. Approve (or Words of Similar Nature):
1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in Paragraph 1.02.B.1. of the General Conditions.
 2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.
- C. Minimum Requirements:
1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
 2. Actual work must comply with (or within specified tolerances) or exceed minimums.
 3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.
- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Includes:
 - 1. Quality Assurance–Control of Installation.
 - 2. Tolerances.
 - 3. Manufacturers' Field Services and Reports.

1.02 QUALITY ASSURANCE–CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Temporary utilities.
 - 2. Temporary stairs and access.
 - 3. Temporary support facilities.
 - 4. Removal of temporary facilities.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
 - 1. Furnish all necessary labor and materials.
 - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
 - 3. Maintain such connections.
 - 4. Remove temporary installation and connection when no longer required.
 - 5. Restore services and sources of supply to proper operating conditions.

1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Temporary Electrical Services:
 - 1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. Services shall be a minimum of 200 amperes, 1 phase, 3 wire, 120/240 volt temporary power and lighting system adequate for the construction of this Project and in accordance with OSHA Requirements for Construction Projects. Installation of the temporary power and lighting system is to begin upon notification to proceed and shall be installed and routed in a manner so as not to interfere with construction of the Project. CONTRACTOR shall remove all temporary services when Project is complete.
 - 2. The temporary light and power system shall include temporary service poles, metering facilities, driven ground, fused main disconnect switch, panelboards, branch circuits, outlets and lamps, and the maintenance thereof.
 - 3. Construction areas, aisles, stairs, and ramps shall be illuminated to 5 fc. Construction shops, storerooms, mechanical, and electrical rooms shall be illuminated to 10 fc. Offices illuminated to 30 fc.

4. Temporary lights shall be equipped with heavy-duty electric cords and lamp guards. They must not be suspended by the power supply cord unless it is designed for this use.
 5. Provide one general purpose, 20 ampere, 120 volt, single phase, grounding type receptacle outlet for every 1,000 feet of floor space and tank area. The maximum length of a 20 ampere, 120 volt lighting or power circuit shall not be greater than 200 feet from panelboard to farthest outlet. All single phase receptacle outlet circuits shall have approved ground-fault circuit interrupter protection.
 6. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
 7. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.
- C. Weather Protection and Temporary Heat:
1. CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.
 2. CONTRACTOR shall provide temporary heat within buildings, without cost to OWNER, from the time the buildings or portions thereof are enclosed until the Project is accepted or occupied by OWNER, whichever occurs first. The building work is to be heated during construction so a minimum temperature of 50°F is maintained at all times. Temporary heating equipment shall be properly vented.
 3. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.
- D. Temporary Telephone Service: CONTRACTOR shall provide, without extra cost to OWNER, telephone services at the Site for phones and computer modems specified in Section 01 52 13—Field Offices and Sheds for the duration of the Work at the Site. Also provide service as required for CONTRACTOR's use. Party making toll calls shall pay for same.
- E. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. CONTRACTOR shall receive permission from OWNER prior to using OWNER's potable water. CONTRACTOR shall estimate use and reimburse OWNER for cost of water. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.
- F. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.
- G. CONTRACTOR's and Subcontractor(s)' personnel shall refrain from smoking during excavation, laying pipe, backfilling, and other work at the Site which may involve potential contact with explosive vapors or gasoline products.

1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

1.05 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.
- C. Minor temporary facilities which interfere with OWNER's operations shall be removed at the end of each Work period.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 52 13
FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Materials, equipment, and furnishings.
 - 2. Construction.
 - 3. Environmental control.
 - 4. CONTRACTOR office and facilities.
 - 5. ENGINEER Office.
 - 6. Storage areas and sheds.
 - 7. Preparation.
 - 8. Installation.
 - 9. Maintenance and cleaning.
 - 10. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50 footcandles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

2.04 CONTRACTOR OFFICE AND FACILITIES

- A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.
- B. Provide telephone as required for CONTRACTOR's needs.
- C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

2.05 ENGINEER OFFICE

- A. CONTRACTOR shall provide separate trailer for sole use of ENGINEER, with separate entrance door with new lock and two keys.
- B. Minimum area shall be 200 square feet, minimum dimension 8 feet.
- C. Minimum total area of windows shall be 10% of floor area, with operable sash and insect screens. Locate to provide views of construction area.
- D. Electrical distribution panel shall have two circuits minimum, 110 volt, 60 Hz service. Provide minimum four 110 volt duplex convenience outlets, one on each wall.
- E. Provide bottled drinking water dispenser and refill as necessary.
- F. Provide the following furnishings:
 - 1. One desk, minimum 54-inch by 30-inch, with three drawers.
 - 2. One drafting table, 36-inch by 72-inch, with one equipment drawer.
 - 3. Plan rack to hold working drawings, shop drawings, and record documents.
 - 4. One standard four-drawer legal size metal filing cabinet.
 - 5. Six linear feet of metal bookshelves.
 - 6. One swivel armchair.
 - 7. Two straight chairs.
 - 8. One drafting table stool.
 - 9. One tackboard, 36-inch by 30-inch.
 - 10. One wastebasket.

2.06 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01 60 00–Materials and Equipment.

PART 3-EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

- A. CONTRACTOR shall install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed or as agreed upon by ENGINEER.
- B. Provide two hard surfaced parking spaces for use by ENGINEER, connected to office by hard surfaced walk.

3.03 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

3.04 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Dust Control.
 - 2. Water, Erosion, and Sediment Control.
 - 3. Noise Control.
 - 4. Traffic Control.
 - 5. Site Security.
 - 6. Daily Cleanup.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION, AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands. Erosion control shall be in accordance with Specification Section 31 25 00 and applicable permits.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area. Dewatering shall be done in accordance with Section 31 23 19 and applicable permits.

- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.
- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.

3.03 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

3.04 TRAFFIC CONTROL

- A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen, and other traffic control devices in the construction zone.
- B. Do not close or obstruct roadways without approval of OWNER.
- C. Conduct operations with minimum interference to roadways.
- D. All traffic control measures shall meet the requirements of the Ohio Manual on Uniform Traffic Control Devices.

3.05 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

3.06 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

SECTION 01 60 00

MATERIALS AND EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to review that:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Accessories and installation hardware are correct.
 - 4. Containers and packages are intact and labels legible.
 - 5. Products are protected and undamaged.

1.05 STORAGE AND PROTECTION

- A. General:
 - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
 - 2. Any additional off-site space required shall be arranged by CONTRACTOR.
 - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
 - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
 - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
 - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
 - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
 - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
 - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
 - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
 - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
 - 2. Store tools or equipment that carry dirt outside.
 - 3. Store large equipment so as not to damage the Work or present a fire hazard.
 - 4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.

5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

1.08 EQUIPMENT WARRANTIES

- A. Warranties shall be nonprorated, include all parts and labor, and be in written form. Warranties shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 72 hours of notification by OWNER. Warranty language shall be provided with the shop drawings.

1.09 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3 1/2-inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.
- B. Concrete and grout shall meet applicable sections of the specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 73 29

CUTTING, PATCHING, AND ALTERATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to install improperly sequenced Work.
 - 3. Remove and replace defective Work.
 - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 5. Remove samples of installed Work as specified for testing.
 - 6. Provide penetrations of surfaces for installation of piping and electrical conduit.

1.02 REFERENCES

- A. ANSI A10 Safety Requirements for Construction and Demolition.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.
- B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

1.04 SUBMITTALS

- A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
 - 1. Work of OWNER or any separate contractor.
 - 2. Structural value or integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance, or safety of operational elements.
 - 5. Visual qualities of sight-exposed elements.
- B. The request shall include:
 - 1. Description of affected work.
 - 2. The necessity for cutting, patching, or alteration.
 - 3. Effect on work of OWNER, any separate contractor, or on the structural or weather-proof integrity of the Project.
 - 4. Description of proposed work to include:
 - a. Scope of cutting, patching, or alteration.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 - 5. Alternatives to cutting and patching.

- 6. Written permission of any separate contractor whose work will be affected.
- C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

1.05 SCHEDULING AND COORDINATION

- A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.
- B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the existing building, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the work. Temporary facilities, if required, shall be in place prior to disruption of service.

PART 2-PRODUCTS

2.01 NEW MATERIALS

- A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.
- B. All new materials for patching and extending work shall match existing products and work.
- C. CONTRACTOR shall determine type and quality of existing products by inspection and any necessary testing and workmanship by use of existing as the standard.

2.02 SALVAGEABLE MATERIAL

- A. Materials or items designated to become the property of OWNER shall be as specified or as shown on the Drawings.
- B. CONTRACTOR shall remove such items with care.
- C. Items which are not to be reinstalled but are to become the property of OWNER shall be removed by CONTRACTOR with care, cleaned, and stored in a location at the Site to be approved by OWNER.

2.03 UNSALVAGEABLE MATERIALS

- A. Materials or items demolished and not designated to become the property of OWNER or not designated to be reinstalled shall become the property of CONTRACTOR and shall be removed from the site and legally and properly disposed of by CONTRACTOR.
- B. Materials shall be removed by CONTRACTOR in a manner that will avoid damage to materials or equipment to remain.

PART 3-EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall inspect existing conditions including elements subject to movement or damage during cutting, patching, and other alterations.
- B. After uncovering the work, CONTRACTOR shall inspect conditions affecting installation of new products or performance of new work.
- C. CONTRACTOR shall report unsatisfactory or questionable conditions to ENGINEER in writing.
- D. CONTRACTOR shall not proceed with work until unsatisfactory or questionable conditions are resolved.
- E. Beginning of cutting, patching, and alterations work means acceptance of existing conditions by CONTRACTOR.

3.02 PREPARATION AND PROTECTION

- A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.
- B. Temporary supports must adequately carry all existing and imposed load.
- C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.
- D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt, and debris from entering into finished areas or areas where OWNER is operating, storing, or manufacturing products.
- E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.
- F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the work which may be exposed by cutting and patching, demolition, or other alterations.
- G. CONTRACTOR shall cut, move, or remove items as necessary for access to alterations and renovations work and replace and restore at completion of work.
- H. CONTRACTOR shall prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.
- I. CONTRACTOR shall be responsible for any damage to the existing structure or its contents directly or indirectly by its crews or those of its subcontractors.

3.03 PERFORMANCE

- A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching, or other alterations using only persons skilled in the appropriate trade.
- B. CONTRACTOR shall execute the work in a careful and orderly manner with the least possible disturbance to the public and to the occupants of the building.
- C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.
- G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.

3.04 DEMOLITION, CUTTING, AND REMOVAL

- A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.
- B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.
- C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
- E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.
- F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.
- G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.
- H. CONTRACTOR shall not let piled waste material endanger the structure.

3.05 PATCHING, EXTENDING, AND MATCHING

- A. Patching work shall conform to the standards of the Specifications where applicable, and where not specified, work shall conform to the highest standards of the applicable trade.
- B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.
- C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.
- D. CONTRACTOR shall provide adequate support to substrate for patching finishes.
- E. Transitions: CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of work.

END OF SECTION

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Closeout procedures.
 - 2. Final cleaning.
 - 3. Adjusting.
 - 4. Project record documents.
 - 5. Warranties.

1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work or designated portion thereof for substantial completion.
 - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
 - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
 - 3. Submit consent of surety (if surety required in Contract).
 - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
 - 1. Removal of trash and rubbish from these areas.
 - 2. Broom cleaning of floors.
 - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.
- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to provide smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall make entries that are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by addenda and modifications.
- F. Record Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.

1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections and as follows.
- B. Submit warranty information as follows:
 - 1. Provide notarized copies.
 - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
 - 3. Submit with request for certificate of Substantial Completion.
 - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 91 00
STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. General.
 - 2. Equipment and system installation.
 - 3. Starting equipment and systems.
 - 4. Demonstration, instructions, and operator training.
 - 5. Start-up and testing.
 - 6. Equipment systems requiring certification of proper installation.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 GENERAL

- A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services because of equipment malfunction or other problem, such time shall be at the expense of CONTRACTOR, with no change in Contract Price.
- B. "Days" specified shall consist of 8-hour days on-site, excluding travel time.
- C. CONTRACTOR shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of ENGINEER and OWNER. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers with sufficient time to allow their compliance with the service requirements.
- D. CONTRACTOR shall manage equipment checkout such that checkout has been completed and deficiencies addressed prior to demonstration and training. Scheduling training prior to checkout may result in cancellation when checkout cannot be completed prior to training.

1.03 EQUIPMENT AND SYSTEM INSTALLATION

- A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems for as many days as may be necessary to provide proper installation and to resolve assembly or installation problems at the site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers for all equipment furnished, whether or not specifically set forth in the Specifications.
- B. Where a manufacturer's certificate is called for in this Specification Section, the manufacturer's representative shall provide the attached certificate stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable safety equipment has been properly installed, that the proper electrical and mechanical connections have been made, and that

any other manufacturer requirements have been met. This certification shall be provided to ENGINEER and OWNER prior to the start-up. This certificate is in addition to the manufacturer's standard startup reports, checklists, and other pertinent information.

- C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for start-up.
- D. Manufacturer shall demonstrate, using laser alignment equipment, if appropriate, that the installed equipment has been aligned properly. Final acceptance of equipment will not be granted until manufacturer has demonstrated to ENGINEER that acceptable alignment to tolerances have been achieved. For pumps with motors 7.5 hp and larger, the acceptable shaft alignment tolerances shall be as recommended in the pump manufacturer's written instructions and shall include parallel offset and angular gap measurements.

1.04 STARTING EQUIPMENT AND SYSTEMS

- A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary as a result of any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.
- B. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by OWNER for full-time operation.
- C. Coordinate schedule for start-up of various equipment and systems. Coordination includes, but is not limited to, communication with subcontractors, suppliers, OWNER, and ENGINEER. CONTRACTOR shall confirm that all necessary work is complete and that the equipment and systems can be operated in conjunction with all associated processes.
- D. Notify ENGINEER and OWNER a minimum of 7 days prior to start-up of each item using the attached Equipment Startup and O&M Training Scheduling form. CONTRACTOR shall submit form to ENGINEER.
- E. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- F. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- G. Verify wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- I. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation. Authorized representative shall provide approval for starting of systems in writing where specified.

- J. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report. In addition, CONTRACTOR shall submit a fully executed Certificate of Proper Installation form if required in Paragraph 3.01 of this section.

1.05 DEMONSTRATION, INSTRUCTIONS, AND OPERATOR TRAINING

- A. For all mechanical equipment and systems and where called for in the Specifications, provide a qualified technical representative to provide detailed instructions to OWNER's personnel for operation and maintenance of equipment and associated instrumentation. Training services shall include pre-start-up classroom instruction and start-up on-site instruction, as stated in the Specifications.
- B. Refer to the Specifications for additional training requirements.
- C. CONTRACTOR shall coordinate the pre-start-up training periods with OWNER's operating personnel and manufacturers' representatives.
 - 1. Schedule training dates and times with OWNER, that are acceptable to the OWNER, using equipment, startup, and O&M training form. Normal hours available for training are between 7:30 A.M. to 3 P.M., Monday through Friday, except for holidays.
 - 2. Submit outline and presentation to ENGINEER at least 7 days in advance of training.
 - 3. Provide name, contact information, and brief synopsis of qualifications of the trainer.
 - 4. If materials above are not provided at least 7 days in advance, training may be canceled.
 - 5. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify OWNER 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour, training will be rescheduled. CONTRACTOR shall reimburse OWNER via a change order.
 - 6. During the training, instructor will dedicate its time solely to training and not start-up services.
 - 7. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
 - 8. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment.
 - 9. Prepare and insert additional data in operation and maintenance manuals when need for additional data becomes apparent during instruction.
 - 10. OWNER may videotape the training for future internal use. Provide to OWNER paper and electronic copies of any media used as part of training.
 - 11. Provide training handouts for each of OWNER's personnel present.
- D. CONTRACTOR shall provide attached Certificate of Operator Training cosigned by OWNER and supplier's representative verifying training was accomplished to satisfaction of all parties.

- E. Operation and maintenance manual submitted in accordance with Section 01 33 00–Submittals shall be provided prior to operator training.
- F. For equipment or systems requiring seasonal operation, perform demonstration for dormant season at start of dormant season.
- G. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER’s satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer’s services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

1.06 START-UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical power and control equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 EQUIPMENT SYSTEMS REQUIRING CERTIFICATION OF PROPER INSTALLATION

- A. All Space and Process related heating, cooling, and ventilation equipment and systems specified in Division 13.
- B. Section 26 09 00–Controls and Instrumentation.
- C. Section 26 09 00–Controls and Instrumentation (PART 3–EXECUTION).
- D. Section 26 32 13–Standby Power System.
- E. Section 26 36 23–Automatic Transfer Switches.

- F. Section 40 05 59.23–Slide Gates.
- G. Section 43 11 33–Tri-Lobe Positive Displacement Blowers.
- H. Section 43 25 10–Submersible Pumps.
- I. Section 46 21 13–Mechanical Fine Screen.
- J. Section 46 43 21–Secondary Clarifier Collectors.
- K. Section 46 51 21–Coarse Bubble Mixing Assemblies.
- L. Section 46 51 46–Membrane Diffusers.
- M. Section 46 66 56–Ultraviolet Disinfection System.

END OF SECTION

TS No. _____

EQUIPMENT START-UP AND O&M TRAINING SCHEDULING FORM
STRAND ASSOCIATES, INC.®

PROJECT _____ CLIENT _____

CONTRACT _____

CONTRACTOR _____ Date: _____

The following equipment is scheduled for start-up on _____

EQUIPMENT NAME: _____ SPECIFICATION SECTION: _____

MANUFACTURER: _____ MINIMUM HOURS OF TRAINING: _____

DATE O&M MANUALS SUBMITTED: _____

Specification Section 01 91 00 requires that start-up and operation and training be conducted by a qualified manufacturer's representative prior to placing equipment in operation. Review Specification Sections 01 33 00 and 01 45 00 and the individual equipment sections for start-up and training requirements. OWNER may find it necessary to propose alternate dates for training based on conflicts with other training and staff availability. The Operation and Maintenance Manuals must be submitted prior to training.

After the equipment or system has been properly installed and is functioning correctly, submit a written report in accordance with Specification Section 01 45 00.

Submit the completed form to ENGINEER and OWNER at least 7 days prior to start-up and training.

Proposed Training Date: _____ Time of Training: _____

Factory-trained representative giving training:

Name(s): _____

Company: _____

Address: _____

Phone: _____

Fax: _____

E-mail: _____

CERTIFICATE OF PROPER INSTALLATION

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

This form shall be completed and submitted to ENGINEER prior to OWNER training.

CERTIFICATE OF OPERATOR TRAINING

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has instructed OWNER's personnel in the start-up operation and maintenance of this equipment as required in the Specifications.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

OWNER

I hereby certify that my operating personnel received instruction for start-up, operation, and maintenance of this equipment.

Signature _____ Date _____

Name (print) _____

Title _____

END SECTION

SECTION 03 11 00
CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Forms for cast-in-place concrete.
 - 2. Form accessories.
 - 3. Openings for other work.
 - 4. Form stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117–Tolerances for Concrete Construction.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 318–Building Code Requirements for Reinforced Concrete.
- D. ACI 347–Recommended Practice for Concrete Formwork.
- E. PS1–Construction and Industrial Plywood.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.

PART 2–PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.

- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

2.03 FORM TIES–REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with either a neoprene plug, Sure-Plug by Dayton Superior, Inc., or an EPDM rubber plug, X-Plug by Sika Greenstreak, or equal.
- C. Cementitious waterproofing material for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal. Taper tie holes above the normal operating water surface shall be patched with mortar mix as specified in Section 03 30 00–Cast-in-Place Concrete for patching tie holes.

2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

PART 3-EXECUTION

3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8 inches from a circle through pan edges will not be allowed.
- D. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- E. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- F. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- G. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- H. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- I. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.
- J. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- K. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.
- C. Forms shall not be removed before the expiration of the minimum times as stated below or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by ENGINEER.
 - 1. Wall and vertical faces: 24 hours.
 - 2. Beams and elevated slabs: 14 days.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
 - 1. ACI 315–Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 2. ACI 318–Building Code Requirements for Reinforced Concrete.
 - 3. ASTM A1064–Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 4. ASTM A615–Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A996–Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
 - 6. ASTM C1116–Standard Specification for Fiber-Reinforced Concrete.
 - 7. CRSI–Manual of Standard Practice.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00–Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
 - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
 - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
 - 3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
 - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Steel wire and welded wire fabric shall comply with ASTM A1064. Fabric shall be provided in flat sheets. Rolled fabric shall not be used.
- C. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
 - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
 - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
 - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
 - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- D. Fibrous Reinforcing:
 - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
 - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
 - 3. Physical Characteristics:
 - a. Specific Gravity: 0.91.
 - b. Fiber Length: Multidesign gradation.
- E. Mechanical Splices and Threaded Couplers:
 - 1. Mechanical splices shall be Zap Screwlok by Bar Splice Products, Inc., or equal.
 - 2. Threaded couplers and dowel bar replacements shall be Dowel Bar Splicer System by Dayton/Richmond, or equal.
 - 3. Mechanical splices and couplers shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

2.02 FABRICATION

- A. General:
 - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
 - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
 - 3. Unless otherwise shown on the drawings, all end hook dimensions shall conform with "ACI Standard Hooks."

- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on drawings or final shop drawings.
 - 3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3–EXECUTION

3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with the specified standards for details and methods of placing reinforcement and supports.
 - 2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.
- B. Placing Reinforcement:
 - 1. All reinforcing shall be placed in accordance with Contract drawings and with shop drawings stamped and approved by ENGINEER.
 - 2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
 - 3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
 - 4. Unless otherwise shown on the drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
 - a. Three inches of cover where the concrete is placed directly against ground.
 - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
 - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
 - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
 - 5. Reinforcement shall be positioned within $\pm 3/8$ -inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be $\pm 1/2$ inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
 - 6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to ENGINEER. Tack welding of reinforcing will not be permitted.

7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
 9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ± 4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
 10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the drawings and specifications.
- C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
 2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
 3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
- D. Welded Wire Fabric:
1. Install welded wire fabric in as long of lengths as practicable.
 2. Lap adjoining pieces at least one full mesh.
 3. Fabric shall be supported with bar supports.
- E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
 2. Lap splices in reinforcing shall be provided as shown on the drawings. Where lap splice lengths are not shown on the drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
 3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
 4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
 5. Mechanical splices and threaded dowel bar inserts may be used where approved by ENGINEER.
- F. Embedded Items:
1. Allow other trades to install embedded items as necessary.
 2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of No. 4 at 8-inch centers each way in members 10 inches or less in thickness and No. 5 at 12-inch centers each way in each face in members greater than 10 inches thick.

H. Fibrous Reinforcing:

1. Fibrous concrete reinforcing shall be used in all building interior slab-on-grade concrete and all precast concrete topping, and where shown on the drawings.
2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All cast-in-place concrete as shown except as noted otherwise.
 - 2. Hydrophilic waterstops, expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, grout topping, floor sealer, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Specifications for Structural Concrete.
- C. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Guide to Hot Weather Concreting.
- E. ACI 306R—Guide to Cold Weather Concreting.
- F. ACI 308—Specification for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Standard Specification for Concrete Aggregates.
- K. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88—Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94—Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.
- P. ASTM C150—Standard Specification for Portland Cement.

- Q. ASTM C156—Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
- R. ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494—Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- X. ASTM C652—Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Y. ASTM D994—Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- Z. ASTM D1752—Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00—Submittals.
- B. Submit the following information:
 - 1. Gradation of fine and coarse aggregate—ASTM C33.
 - 2. Specific gravity and dry rodded density of each aggregate.
 - 3. Test of deleterious substances in fine and coarse aggregate—ASTM C33.
 - 4. Design mix of each individual concrete mix to be used.
 - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
 - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

PART 2—PRODUCTS

2.01 CEMENT

- A. Cement shall be Portland cement conforming to ASTM C150. Cement used for structures exposed to wastewater, sludge, combined sewage, or sanitary sewage shall be Type II or Type I/II. All other cement shall be Type I or Type I/II. Type III cement shall be used only

when permitted by ENGINEER. All cement shall be the product of one reputable manufacturer and mill.

- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.
- C. If required by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60

Percentage by Weight	
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If required by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-inch Stone	1 1/2-inch Stone
Passing 2-inch sieve	---	100
Passing 1 1/2-inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

- H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate comprising between 35% and 65% of the total course aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.
- I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.

- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash- Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
X	---	2,000	376	---	---

- C. Except as otherwise indicated on the drawings or specified, all concrete shall be Class A or Class A-FA concrete.
- D. Grout for clarifier bottoms shall contain pea gravel, crushed stone, or other suitable coarse aggregate graded from 1/8 inch to 3/8 inch in addition to well-graded sand. Use six bags of Portland cement and 100 pounds of Class C fly ash per cubic yard. Not more than 35 gallons of mixing water per cubic yard, including free water in aggregate, shall be used. Minimum 28-day design strength shall be 4,000 psi. Provide similar mix with fibrous reinforcing added for concrete topping over precast plank.
- E. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a competent concrete engineer or competent laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.
- F. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.
- G. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.

- H. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- I. CONTRACTOR shall submit to ENGINEER concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.
- J. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

2.07 WATERSTOPS

- A. Hydrophilic waterstop shall be a flexible hydrophilic natural rubber strip composed of nonvulcanized rubber and urethane polymer hydrophilic agent creating a moisture-activated, self-healing waterproofing compound.
- B. Hydrophilic waterstop shall be Adeka Ultraseal, or equal, products as follows:
 - 1. Construction Joints:
 - a. Wall/slab thickness greater than 9 inches with double mat of reinforcing: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control. The waterstop shall develop a minimum of 400 psi expansion pressure and withstand a minimum 150-foot hydrostatic head. Expansion amount shall not exceed 120%.
 - b. Wall/slab thickness between 4 inches and 9 inches with 1-inch minimum cover and single or double mat of reinforcing: KBA-1510FP (9/16 inch by 3/8 inch). Expansion amount shall not exceed 30%.
 - 2. Pipe Penetrations:
 - a. Wall/slab thickness between 4 inches and 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: KBA-1510FP (9/16 inch by 3/8 inch).
 - b. Wall/slab thickness greater than 9 inches and pipe diameter greater than 4 inches and less than or equal to 24 inches: MC-2005T (3/4 inches by 3/16 inches).
 - c. Wall/slab thickness greater than 9 inches and pipe diameter greater than 24 inches: MC-2010MN (3/4 inch by 3/8 inch) with embedded stainless steel wire mesh for expansion control.

2.08 JOINT FILLER

- A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler, W. R. Meadows, or equal, meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

2.09 BONDING AGENT

- A. Acceptable manufacturers include MasterProtect® P 110 by Masters Builders Solutions in non-submerged applications and MasterEmaco® P 124 by Masters Builders Solutions in submerged applications, or equal.

2.10 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Masters Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

2.11 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

2.12 CURE–SEAL HARDENER

- A. Penetrating sealer for interior building floors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See finish schedule for locations to be used.

PART 3–EXECUTION

3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
 1. Date.
 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
 3. Type of cement and admixtures, if any.
 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.

5. Amount of concrete in load, in cubic yards.
 6. Water-cement ratio.
 7. Water added at job, if any.
 8. Truck number and time dispatched.
 9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the drawings or specified herein. If approved by ENGINEER, CONTRACTOR may, at his own expense, place construction joints in addition to and at places other than those shown on the drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.
- B. Where joints are not shown on the drawings or specified elsewhere, CONTRACTOR shall provide joints as follows:
1. Walls shall have vertical joints at 60 feet on center maximum but not more than 15 feet from corners or intersections and shall have horizontal joints at 15 feet on center maximum.
 2. Slabs shall have joints at 20 feet on center maximum in each direction.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

3.03 WATERSTOPS

- A. Hydrophilic waterstop shall be provided at all construction joints in liquid holding tanks and channels that are not adjacent to areas occupied by personnel and at joints between new and existing concrete. Waterstop shall be placed as shown on drawing details, if any, and in accordance with the manufacturer's recommendations.

3.04 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new

pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

3.05 PATCHING EXISTING CONCRETE

- A. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

3.06 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.07 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.

- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.08 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
 - 1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
 - 2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
 - 3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
 - 4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
 - 5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.

6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
 7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.09 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.10 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than 3 successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 306.1.
- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed

shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.

- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.11 FINISHING

- A. Flat Work:
 - 1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
 - 2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
 - 3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
 - 4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
 - 5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

6. The above finishes shall be used in the following locations:
 - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
 - b. Light Troweled Finish: Submerged tank slabs.
 - c. Hard Troweled Finish: Building floors.
 - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.
- B. Formed Surfaces:
1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
 2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
 3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
 4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
 5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
 - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces (See Section 09 91 00 for painted surfaces), interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
 - b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
 - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inches in any dimension. Surface imperfections greater than 3/8 inches shall be

repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

- d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.12 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

3.13 WATER TEST

- A. All liquid-retaining structures shall be water-tested by CONTRACTOR before being faced with masonry or backfilled. The structure shall be filled with water, kept full for at least 24 hours, leaks or moist areas marked, and the structure or surrounding area drained. Repairs shall be made from the face of the concrete that is subjected to water pressure. Method of repair shall be reviewed by ENGINEER.
- B. Testing of the structure shall not take place until the last concrete placed in the structure has developed 28-day design strength as determined by testing field-cured concrete cylinders.
- C. After repair, the structure shall again be tested as above. Testing and repair shall continue until all leaks or moist spots have disappeared. Unless otherwise stated, water for testing shall be supplied by CONTRACTOR.

3.14 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.15 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at his expense.
 - 1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
 - 2. Cylinders:
 - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight

test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.

- b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.
 - c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
 - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be transmitted immediately and directly to ENGINEER and OWNER. Test data shall include date and location of pour and concrete mix used.
3. Slump Test: CONTRACTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
 4. Air Test:
 - a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
 - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.16 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The project representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.17 GROUT TOPPING AND FILL

- A. The clarifier bottoms shall receive a 2-inch concrete topping as specified below. The topping coat shall be struck off by placing a screen on clarifier mechanism arms and rotating the mechanism. After striking off, a light steel troweled finish shall be applied. CONTRACTOR shall run the clarifier mechanism.
- B. Before the grout topping is applied, the base slab shall be thoroughly cleaned. The base slab shall be wetted and kept saturated prior to placing the topping. A thin coat of cement grout shall be broomed into the base slab for a short distance ahead of the topping. The topping shall be applied before the grout is hardened.

3.18 SIDEWALKS AND EXTERIOR SLABS

- A. Sidewalks shall be constructed where shown on the drawings. They shall be a minimum of 5 inches thick and shall slope away from buildings or structures at a rate of 1/4 inch per foot.

Concrete shall be as previously specified. Sidewalks shall be constructed on 3 inches of compacted granular fill. They shall have tooled joints of 1-inch minimum depth at approximately 5-foot centers with 1/2-inch preformed expansion joint filler at approximately 25-foot centers with one at all corners and located anywhere sidewalks abut structures and buildings.

3.19 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

3.20 CURING AND SEALING INTERIOR BUILDING FLOORS

- A. Install cure-seal hardener product in accordance with manufacturer's instructions. Apply only to those floors noted to be sealed in the finish schedule.
- B. Where product will be used for moist curing, sealing and hardening, apply to new concrete as soon as the concrete is firm enough to walk on after troweling. Where product will be used for sealing and hardening only, surface must be free of dust, dirt, laitance, curing compounds, and any material that would inhibit the penetration of the product. In some instances, the floor may need to be stripped and neutralized before application.
- C. Spray on at rate of 200 square feet per gallon.
- D. Keep surfaces wet with cure-seal hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather, slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal hardener as required to keep entire surface in a nonslippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a nonslippery state.
- E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.
- F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal hardener.
- G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
- H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.
- I. Protect installed floors until chemical reaction process is complete; at least 3 months.
- J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained because of improper precautions or lack of cleaning.

END OF SECTION

Section 03 30 00-16

4640.003/1-2021

SECTION 04 05 13

MORTAR AND MASONRY GROUT

PART 1–GENERAL

1.01 SUMMARY

- A. The work includes mortar and grout for masonry.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. 2017 Ohio Building Code.
- B. ASTM C91–Masonry Cement.
- C. ASTM C144–Aggregate for Masonry Mortar.
- D. ASTM C150–Portland Cement.
- E. ASTM C207–Hydrated Lime for Masonry Purposes.
- F. ASTM C404–Aggregates for Masonry Grout.
- G. ASTM C476–Grout for Masonry
- H. ASTM C979–Pigments for Integrally Colored Mortar/Concrete.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.
- C. Submit design mix for grout including gradation of aggregates.
- D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. See Section 04 20 00–Unit Masonry System, for cold weather requirements.

PART 2-PRODUCTS

2.01 MORTAR

- A. Mortar shall be Type S Portland cement-lime mortar or masonry cement mortar with proportion restrictions as stated in the 2017 Ohio Building Code. Provide integral waterproofing compound in mortar for all exterior masonry mortar.
- B. Portland cement shall conform to ASTM C150, Type I or III.
- C. Hydrated lime shall conform to ASTM C207, Type S.
- D. Masonry cement shall conform to ASTM C91.
- E. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.
- F. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

- G. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.
- H. Water used in mixing water shall be clean and free of injurious materials.
- I. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.
- J. Colored mortar shall be provided for split face block mortar. Colored mortar shall be Western Colored Masons Blend, premixed and colored as manufactured by Western Lime and Cement Company or equal. Color shall be selected by OWNER. White cement and sand will not be required.

2.02 GROUT

- A. Grout shall conform to ASTM C476-Mortar and Grout for Reinforced Masonry.
- B. Aggregates shall conform to ASTM C404-Aggregates for Masonry Grout.

- C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
 - 1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
 - 2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.
- D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inches and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Brace masonry for wet grout pressure.
- B. Work grout into masonry cores and cavities.
- C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.
- D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the drawings.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Concrete block.
 - 2. Split-face block.
 - 3. Reinforcement, anchorage, control joints, and accessories.
 - 4. Cold weather requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. 2017 Ohio Building Code.
- B. ASTM C67–Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C90–Standard Specification for Loadbearing Concrete Masonry Units.
- D. ASTM C216–Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- E. ASTM C744–Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
- F. UL–Fire Resistance Directory.

1.03 QUALITY ASSURANCE

- A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4 inch in 10 feet, 3/8 inch in a story height or 20 feet maximum or 1/2 inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4 inch in any story or 20 feet maximum or 1/2 inch in 40 feet or more.
- B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4 inch in any bay or 20 feet or 1/2 inch in 40 feet or more.
- C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2 inch in any bay or 20 feet maximum or 3/4 inch in 40 feet or more.
- D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4 inch or plus 1/2 inch from the dimensions indicated on the drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean, and shall be covered.

1.05 COLD WEATHER REQUIREMENTS

- A. All masonry units delivered to use in freezing weather shall be fully protected by a weathertight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.
- B. Cold Weather Protection:
 - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 - 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
 - 3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
 - a. When air temperature is from 32°F (0°C) to 25°F (-4°C), heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
 - b. When air temperature is from 25°F (-4°C) to 20°F (-7°C), heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
 - c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
 - 4. Perform the following protections for completed masonry and masonry not being worked on:
 - a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
 - b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.
 - c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.
 - d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

PART 2—PRODUCTS

2.01 CONCRETE BLOCK

- A. Concrete block shall be load bearing and shall conform to the requirements of ASTM C90 and the 2017 Ohio Building Code. Bond shall be running bond. Concrete block shall be the two-cell type and shall be made with normal weight aggregate.

- B. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.
- C. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.
- D. Provide sash units with integral dovetail slots at masonry control joints.

2.02 DECORATIVE CONCRETE BLOCK

- A. Split Face and Smooth Face Block:
 - 1. Split face units shall be used for where shown on drawings. Smooth face units shall be used where shown on the drawings. Nominal face size of units shall be 8 inches by 16 inches. Nominal thickness shall be as shown on the drawings.
 - 2. The block shall be made with an integral coloring compound and an integral waterproofing compound. The block shall be made with normal weight aggregate and shall meet ASTM C33 and ASTM C90.
 - 3. The integral waterproofing compound shall be DRY-BLOCK SYSTEM, Block Admixture as manufactured by W.R. Grace & Co., Cambridge, MA, or equal. The admixture manufacturer shall determine the amount of compound to be used. The admixture used in the block shall be of the same manufacture as used in the mortar.
 - 4. Block colors shall be selected by OWNER.

2.03 REINFORCEMENT AND ANCHORAGE

- A. For concrete block walls, masonry wall reinforcement shall be 220 Ladder-Mesh manufactured by Hohmann & Barnard, Inc., Ladder Wire, manufactured by Wire-Bond, or equal.
- B. For cavity walls, masonry wall reinforcement shall be 265 Ladder Adjustable or manufactured by Hohmann & Barnard, Inc., Ladder Adjustable Tab by Wire-Bond, or equal.
- C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.
- D. Side rods shall be 9 gauge wire, and cross rods and tabs shall be 9 gauge wire. Maximum spacing of tabs shall be 24 inches.
- E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.
- F. Masonry Ties To Concrete Backing: For tying masonry to concrete, unless noted otherwise, use individual dove-tail flat bar or wire anchors, the equivalent of not less than 3/16-inch-diameter steel rods, inserted in slots built into concrete with one tie for not more than 4 1/2 square feet of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance shall not exceed 16 inches. The maximum horizontal distance shall not exceed 36 inches. Ties shall be galvanized.

- G. Masonry Ties to Stud Walls: Ties shall be minimum 22 gauge corrugated sheet steel, 7/8 inch wide with one tie per 2 square feet of wall area.
- H. Reinforcing Bar Positioners: Where vertical reinforcing bars are required, provide bar positioners by Hohmann and Barnard, or equal.

2.04 ACCESSORIES

- A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be UV-resistant polypropylene, QV-Quadro-Vent, or equal.
- B. Vertical expansion control joints shall be located as shown on the drawings. Control joints shall be constructed with a factory-extruded section of rubber equal to RS Series–Rubber Control Joint by Hohmann & Barnard, Inc., Rubber Control Joint by Wire-Bond, or equal, and shall extend for the entire height of the wall. Care shall be taken so that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.
- C. See Section 07 26 00–Vapor and Air Barrier for air barrier on masonry walls.
- D. See Section 07 62 00–Flashing and Sheet Metal for masonry flashing specifications.

PART 3–EXECUTION

3.01 MASONRY WORKMANSHIP

- A. All masonry shall be laid plumb and true to lines. Brick shall be laid with complete full mortar joints. Mortar beds shall be spread smooth or only slightly furrowed. The ends of brick shall be buttered with sufficient mortar to fill the end joint.
- B. All masonry shall be laid in running bond, unless specified otherwise.
- C. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.
- D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins that protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.
- E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods that provide cuts that are straight and true.
- F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections that might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.
- G. Weep holes spaced 32 inches on center 2 1/2 inches high shall be provided in the first course immediately above all flashing. Weep holes shall be kept free of mortar droppings.

- H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4 inch nor more than 3/8 inch wide and shall be cleaned out to a uniform depth of at least 3/4 inch ready for placement of caulk.
- I. All walls shall be adequately braced until they are completed and anchored to the roof construction.
- J. All brick having initial rates of absorption in excess of 0.25 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting of units shall be such so that each unit is nearly saturated, surface dry when laid. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying.

3.02 MORTAR JOINTS

- A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8 inch thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8 inch thick, unless otherwise shown. All joints shall be completely filled.
- B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

3.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the drawings. Extend reinforcement in the second joint above and below openings 2 feet beyond the jambs. All other reinforcing shall be continuous.
- B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to allow for a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.
- C. Vertical reinforcing bars shall be installed using prefabricated bar positioners. Provide one positioner at the top of the first course of block and one additional positioner at a maximum spacing of 200 bar diameters.

3.04 BUILT-IN WORK

- A. As work progresses, install all built-in work (such as window and door frames, anchor bolts, plates, and lintels) to be provided by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."
- D. Do not use built-in organic materials subject to deterioration.

- E. Steel members embedded in exterior masonry shall be “battered” with not less than 1/2 inch of setting mortar on all surfaces.

3.05 JOINING OF WORK

- A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to “stop-off” a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout 4 inches back of the rack. Toothing will not be permitted.

3.06 PROTECTION OF WORK

- A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least 2 feet on each side of the wall and shall be securely anchored.

3.07 MASONRY CONTROL JOINTS

- A. Provide vertical masonry control joints as detailed on the drawings.
- B. Where control joint locations are not shown on the drawings, they shall be provided as follows:
 - 1. Brick veneer:
 - a. Distance from wall corner (maximum): at or near corners.
 - b. Spacing between joints (maximum): 25 feet for panels without openings; 20 feet for panels with openings.
 - c. Additional locations: at changes in wall height.
 - 2. Block veneer:
 - a. Distance from wall corner (maximum): at inside corners and within 4 inches of outside corners.
 - b. Spacing between joints (maximum): 20 feet or 1.5 times veneer height, whichever is less.
 - c. Additional locations: at changes in wall height.
 - 3. Block backup walls and single-wythe block walls:
 - a. Distance from wall corner or intersection (maximum): 12 feet or 0.75 times wall height, whichever is less.
 - b. Spacing between joints: 25 feet or 1.5 times wall height, whichever is less.
 - c. Additional locations: at changes in wall height, at steps on top of foundation walls, and at junctions between shallow and deeper.
- C. Where possible, joints shall be located at one or both edges of door, window, and louver openings and at changes in wall height.

3.08 CLEANING NEW WORK

- A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5% or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces

of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Shop-fabricated carbon steel, stainless steel, and aluminum items, including lintels, metal stairs, ladders, and weirs and baffles.
 - 2. Stair treads and nosings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36–Carbon Structural Steel.
- B. ASTM A53–Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143–Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A240–Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM A276–Stainless Steel Bars and Shapes.
- H. ASTM A307–Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- I. ASTM A384–Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385–Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500–Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A780–Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992–Structural Steel Shapes.
- N. ASTM A1008–Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- O. ASTM A1011—Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- P. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- Q. ASTM B211—Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- R. ASTM B221—Aluminum and-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- S. AWS A2.0—Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS A5.4—Stainless Steel Electrodes for Shielded Metal Arc Welding.
- U. AWS D1.1—Structural Welding Code—Steel.
- V. AWS D1.2—Structural Welding Code—Aluminum.
- W. AWS D1.6—Structural Welding Code—Stainless Steel.
- X. ASTM F593—Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- Y. ASTM F594—Standard Specification for Stainless Steel Nuts.

1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS–CARBON STEEL

- A. Steel Sections:
 - 1. ASTM A36 (channels, angles, plates).
 - 2. ASTM A992 (wide flange sections).
 - 3. Pipe: ASTM A53, Grade B.
 - 4. Tubes: ASTM A500, Grade B.
 - 5. Silicon content of steel members to be hot-dipped galvanized shall be in the range of 0 to 0.04%. Submit mill test reports confirming compliance.
- B. Sheet Steel: ASTM A1011.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Electrodes: Comply with AWS D1.1. E70XX electrodes for carbon steel. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS–STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel bars and shapes shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements of ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.

- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.
- E. Welding Electrodes:
 - 1. Comply with AWS D1.6.
 - 2. Use ER316L electrodes for 316L stainless steel.
 - 3. Use ER308L electrodes for 304L stainless steel.

2.03 MATERIALS–ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Stainless steel.
- E. Welding Materials: AWS D1.2; type required for materials being welded.

2.04 ACCESSORIES

- A. Stair Treads: Stair treads for aluminum stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be IKG Industries, or equal, serrated, aluminum swage-locked treads with 1 1/4-inch abrasive nosing.

2.05 FABRICATION

- A. Fabrication and Assembly:
 - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
 - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
 - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
 - 5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
 - 1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
 - 2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
 - 3. Assemble and weld built-up sections to produce true alignment of axes without warp.
 - 4. Welding shall be done by the shielded arc process.
 - 5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Workmanship:
 - 1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.

2. Work to dimensions shown or accepted on the Shop drawings using proven details of fabrication and support.
3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
5. Cap all open ends of pipe and structural tubing.
6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

- A. Metal Stairs:
 1. Fit and shop-assemble components in largest practical sections for delivery to site.
 2. Fabricate components with joints tightly fitted and secured.
 3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
 4. Treads and risers for metal pan stairs shall be fabricated with 14 gauge sheet steel, closed risers, treads ready to receive concrete.
 5. Aluminum grating stair treads shall be bolted to stringers with aluminum or stainless steel bolts.
 6. Aluminum safety treads shall be screwed to aluminum carrier angles.
- B. Aluminum Ladder: Provide fixed aluminum ladder. Aluminum ladder shall have serrated surface on rungs.

2.07 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09 91 00–Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09 91 00–Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- E. Surfaces that will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
 1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped

- galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in *Recommended Details for Galvanized Structures* as published by the American Hot Dip Galvanizer's Association, Inc.
 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
 4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, *Welding Zinc Coated Steel*. All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- A. Setting Precast Anchorages:
 1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
 2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 3. Pack grout solidly between bearing surfaces and plates so that no voids remain.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including

threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

C. Cutting, Fitting, and Placement:

1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
3. Fit exposed connections accurately together to form tight hairline joints.
4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

- A. 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 in accordance with Section 09 91 00–Painting.

3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting, or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inch in width.
1. Cold Galvanizing Compound:
 - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
 - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
 - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
 2. Zinc-Based Solder:
 - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be wire-brushed.
 - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
 - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed-galvanized and field finish paint in accordance with Division 09.
- C. Aluminum stairs, serrated aluminum treads and landings. Mill finish.
- D. Aluminum ladder.

END OF SECTION

SECTION 05 52 00

HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes steel and aluminum handrails, railings, and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A53–Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM B241–Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

- A. Railings and handrails shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the 2017 Ohio Building Code.
- B. Submit engineering calculations for all rails, posts, and connections demonstrating compliance with the design requirements. Calculations shall be stamped by a Ohio Professional Engineer.

PART 2–PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.
- B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5, Schedule 40, 1 1/2-inch-diameter pipe extrusion.
- C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, 6005-T5, or 6105-T5. Schedule 40, 1 1/2-inch-diameter pipe.
- D. Furnish and install 4-inch by 1/4-inch toeboards where shown or noted on the drawings, or where required by OSHA 1910.29(k).
- E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.

- F. Finished joints shall be smooth.
- G. All rails, posts, toeboards, and connectors shall have a M10C22A41 clear anodized finish.
- H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.
- I. Stainless steel expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05 53 00

GRATING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes floor and stair tread grating.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. NAAMM Metal Bar Grating Manual ANSI NAAMM MBG531 and MBG532.
- C. ASTM B221-Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 PERFORMANCE REQUIREMENTS

- A. Floor grating and plank shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.
- B. Checkered floor plate thickness shall be determined based on a maximum deflection of L/150 of the short side or a stress of 28,000 psi under a 100 psf uniform load. The larger plate thickness shall govern. Where plate thickness does not meet these requirements, or where a thinner plate is desired, CONTRACTOR shall design and provide welded aluminum stiffeners that, in combination with the provided floor plate, meet these load and deflection requirements.

1.04 FIELD MEASUREMENTS

- A. Take all field measurements prior to preparation of shop drawings. Verify that field measurements are as indicated on shop drawings.

PART 2–PRODUCTS

2.01 ALUMINUM FLOOR GRATING

- A. All grating, unless otherwise specified, shall be rectangular bar style, swage-locked aluminum floor grating with serrated surface.
- B. Acceptable manufacturers include the following or equal: Harsco Industrial, IKG Type S-19-4-BS.

- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 1/8-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Individual sections shall be of a size to permit ease in handling with a maximum length not in excess of 8 feet. Weight of individual sections shall not exceed 75 pounds.
- E. Where possible, provide a 12-inch-wide section of grating over each stop gate and over each valve operating nut.
- F. All aluminum grating support angles shall be aluminum. Support angles shall be provided at the bearing ends of all grating. This includes locations such as wall openings and corners. Support angles shall also be provided at the nonbearing ends of grating where shown on the drawings.
- G. For aluminum grating stair treads, refer to Section 05 50 00–Metal Fabrications.
- H. Provide 4-inch by 1/4-inch toeboards anchored to edge of grating at all slide gates in grated areas.

2.02 FINISHES

- A. Protection of Aluminum from Dissimilar Materials:
 - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.
 - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry, or lime mortar, exposed aluminum surfaces shall be painted with multiple coats of bituminous paint, minimum 10 mils dry, or other approved insulating material.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Prior to installation, CONTRACTOR shall inspect supports for correct size, layout, and alignment. Any inconsistencies between contract drawings and supporting structure deemed detrimental to placement shall be reported in writing to ENGINEER prior to placement.

3.02 INSTALLATION

- A. Place embedded frames and supports in correct position, plumb and level. Provide blocking as required to maintain alignment of sections.
- B. Seal small gaps between embedded angles at face of wall with backer rod to prevent concrete entry.

- C. All aluminum floor grating and plank shall be secured to supporting members with aluminum or stainless steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.
- D. Install in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- E. Cutting, Filling, and Placement:
 - 1. Perform all cutting and fitting required for installation.
 - 2. Cutouts for circular obstructions are to be at least 2 inches larger in diameter than the obstruction. Cutouts for all piping 4 inches or less shall be made in the field.
 - 3. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
 - 4. Utilize standard panel widths wherever possible.

END OF SECTION

SECTION 05 56 00

ANCHOR BOLTS AND POST-INSTALLED ANCHORS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36/A36M–Standard Specification for Carbon Structural Steel.
- B. ASTM F1554–Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council–Evaluation Service.
- D. AC 193–Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308–Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2–Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4–Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

PART 2–PRODUCTS

2.01 GENERAL

- A. Unless indicated otherwise on the drawings or specified, use the following bolt material for the various installation situations:
 - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
 - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.02 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.03 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud+ SD2, SD4, or SD6 by DeWalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the 2017 Ohio Building Code, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.
- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

2.04 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the 2017 Ohio Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

2.05 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt by DeWalt, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the 2017 Building Code. They shall be ICC-ES approved for use in cracked and uncracked concrete.

PART 3-EXECUTION

3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.

- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

3.03 ADHESIVE ANCHORS

- A. At locations shown on the drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- E. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.

3.04 SCREW ANCHORS

- A. Unless otherwise noted on the drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION

SECTION 06 11 00

WOOD FRAMING AND SHEATHING

PART 1–GENERAL

1.01 SUMMARY

- A. Work included:
 - 1. Structural roof framing.
 - 2. Roof sheathing.
 - 3. Miscellaneous framing and sheathing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. APA–American Plywood Association.
- C. AWWA–American Wood Preservers Association.
- D. NFPA–National Forest Products Association.
- E. NLGA–National Lumber Grades Authority.
- F. SPIB–Southern Pine Inspection Bureau.
- G. WCLIB–West Coast Lumber Inspection Bureau.
- H. WWPA–Western Wood Products Association.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to provide proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.
- B. All studs shall be 2 inches by 4 inches nominal or 2 inches by 6 inches nominal as shown on the drawings and shall be No. 2 Douglas Fir, No. 2 Southern Pine, or better.

- C. All roof joists, ceiling joists, and floor joists shall be No. 2 Southern Pine or better.
- D. Plywood roof, wall, and ceiling sheathing shall be grade C-D (CDX), Exposure 1, or better, graded in accordance with the American Plywood Association.
- E. Wood sills, plates, blocking, etc., to be same grade as studs.

PART 3—EXECUTION

3.01 FRAMING

- A. General: All rough framing lumber and all other wood framing, studs blocking, and furring shall be accurately set to required lines and levels, closely fitted, shimmed, and rigidly secured in place.
- B. Place all wood studs in sizes as shown and spaced at 16 inches o.c., unless noted otherwise. Erect studs on single bottom and single top plate at nonbearing walls, double studs at all openings, triple studs at corners. Install blocking between studs as required. Bolt plates and blocking to concrete at 32-inch centers, unless noted otherwise. Space framing to receive electrical piping or ductwork without cutting joist. Verify all duct and piping runs prior to framing to eliminate conflict. Stud walls shall extend a minimum of 8 inches above the ceiling line. Stud walls shall be adequately braced off of other stud walls and/or masonry walls.
- C. Construct load bearing, framing, and curb members full length without splices.
- D. Provide double studs at openings over 24 inches wide. Space short studs over and under opening to stud spacing.
- E. Unless shown otherwise, provide double joists at floor and ceiling openings over 24 inches wide and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.
- F. Unless shown otherwise, provide mid-span bridging between joists spanning 12 feet or more. Unless shown otherwise, provide solid wood blocking at ends of joists placed between alternate joist spaces.

3.02 PLYWOOD SHEATHING

- A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 10d common nails.
- B. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Use sheathing clips between sheets between roof framing members, or provide solid edge blocking between sheets.

3.03 CONNECTIONS

- A. All framing connections and nailing shall be in accordance with the details shown and/or the 2017 Ohio Building Code minimum requirements, whichever is more restrictive.
- B. Framing connectors shall be Simpson Strong Tie, Mitek, or equal. Connector numbers shown on details are Simpson. Submit engineering data on any substitutes.

C. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

SECTION 06 17 53

PLATE CONNECTED WOOD TRUSSES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All materials, equipment, and labor necessary for the prefabrication, delivery, and permanent setting of wood trusses on buildings.
 - 2. Bridging.
 - 3. Temporary and permanent bracing.
 - 4. Related hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. APA–American Plywood Association.
- C. ASTM A653–Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, (Structural Physical) Quality.
- D. AWPA–American Wood Preservers Association.
- E. NFPA–National Forest Products Association.
- F. SPIB–Southern Pine Inspection Bureau.
- G. TPI–Truss Plate Institute.
- H. WWPA–Western Wood Products Association.

1.03 DESIGN REQUIREMENTS

- A. The basic design loads shall be in accordance with the 2017 Ohio Building Code.
- B. Dead Loads and Collateral Loads: Trusses shall be designed for a Top Chord dead load of 15 psf, a bottom chord dead load of 5 psf, plus bottom chord collateral load of 5 psf.
- C. Live Loads:
 - 1. Roof live loads shall be computed in accordance with the 2017 Ohio Building Code using a ground snow load of 20 psf, a snow load importance factor of 1.10, and snow exposure and thermal factors as per Code. Minimum roof live load shall be 20 psf. Snow load and minimum roof live load shall be applied to the top chord.
 - 2. Design for unbalanced snow loads in accordance with the building code.
 - 3. Design for sliding and drifted snow loads as shown on the drawings.

4. Roof live loads shall be applied to the horizontal projection of the roof.
 5. Bottom chord Live Load shall be 20 psf.
- D. Wind Loads: Wind loads shall be computed in accordance with the 2017 Ohio Building Code using a 3-second gust wind speed of 90 mph, exposure category C, and an importance factor of 1.15.
- E. Concentrated Loads: Design for any concentrated loads shown on the drawings.
- F. Combination of Loads: The combining of loads for design purposes shall be as prescribed with the 2017 Ohio Building Code.

1.04 SUBMITTALS

- A. Submittals shall be as in Section 01 33 00–Submittals.
- B. Professional Engineer: All truss designs shall bear the name and seal of a State of Ohio licensed professional engineer. CONTRACTOR shall be responsible for submitting the required additional copies of truss drawings with original stamp and signature for submittal to the State of Ohio. These materials must be submitted prior to installation.
- C. Truss designs shall include the following information: Pitch, span, dimensions, and spacing of trusses; truss bearing sizes and locations; design loading of truss and allowable stress increase; axial forces in each truss member; nominal sizes and location of connector plates at all joints; size, species, and stress of grade of lumber for all truss members; camber; permanent lateral bracing as required by design to reduce buckling length of individual truss members; and handling and erection recommendations. Where sheathing is not attached directly to truss bottom chords, provide bottom chord bracing and bridging as required by design to resist wind uplift loads.

1.05 QUALITY ASSURANCE

- A. The design and fabrication criteria of all wood trusses shall meet the following:
1. “National Design Specifications for Stress-Grade Lumber and its Fastenings,” by National Forest Products Association (latest revision).
 2. “Timber Construction Standards,” by American Institute of Timber Construction (latest revision).
 3. “Design Specifications for Light Metal Plate Connected Wood Trusses,” by Truss Plate Institute (latest revision).
 4. 2017 Ohio Building Code.
- B. Fabricator Manufacturer: Minimum three years experience in successful fabrication of trusses comparable to type indicated for this project.
- C. Design Trusses under direct supervision of a professional engineer experienced in design of this work and licensed in the State of Ohio.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Fabricated trusses and subcomponents shall be so handled and stored that they are not subject to damage.

- B. If the trusses are to be stockpiled prior to erection, sufficient bearing points and/or bracing shall be provided to prevent excessive lateral bending or tipping over.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Lumber:
 - 1. All lumber used for truss members shall be Spruce-Pine-Fir, Douglas Fir, Southern Pine, Hem-Fir, or Western Larch and shall conform to lumber for trusses and shall have a minimum nonrepetitive fiber bending strength of 1,050 psi. If design calls for use of a lumber with greater strength, then that lumber shall be used for the associated members.
 - 2. At the time of delivery, the moisture content of all lumber shall not exceed 19% kiln-dried.
 - 3. All lumber shall conform to the species and shall be fully recognized nominal sizes shown on the drawings or truss engineering design.
 - 4. All members shall be cut from lumber which bear the proper grade-mark stamps of a licensed lumber inspection agency.
- B. Connectors:
 - 1. All truss connector plates shall be manufactured from ASTM A653, Grade A, prime commercial quality galvanized sheet steel of no less than 20-gauge thickness which has a minimum yield of 33,000 psi and a minimum ultimate tensile strength of 45,000 psi.
 - 2. The corrosion-resistant coating shall be ASTM A924–Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements, Coating Designation C90 or G60, ASTM A879–Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface, Coating Class C, or such treatment as will give equivalent corrosion protection.
 - 3. The connectors shall have a series of nail-like projections which are designed to separate the fibers of the wood into which they are pressed in accordance with accepted nailing practices.
 - 4. Where field-assembly of truss subcomponents is necessary, the connections shall be in accordance with the details shown on the truss design drawings, approved by a Professional Engineer.

2.02 FABRICATION

- A. All trusses and other roof structural components shall be fabricated in a properly equipped manufacturing facility of a permanent nature. They shall be manufactured by experienced workmen using precision cutting and truss fabricating equipment under the direct supervision of a qualified foreman. All trusses shall be fabricated under strict rules of inspection and quality control as the local code may require and be open to the observation of ENGINEER or his representative at all times.
- B. All truss members shall be accurately cut to length, angle, and be true to line to provide tight joints for finished truss.
- C. All truss members and connector plates shall be properly placed in special jigs and the members tightly clamped in place remaining in that position until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.

- D. Camber shall be built into the trusses, as noted on the engineering truss designs, by properly positioning the members in the fabricating jig. No camber will be allowed on the bottom chord.

PART 3–EXECUTION

3.01 ERECTION

- A. Install trusses in accordance with manufacturer’s instructions and TPI BWT (latest revision).
- B. Framing anchors and/or truss hangers shall be provided by CONTRACTOR, as required, or detailed to withstand all loads, both dead and live, as well as wind and transfer loads to bearing.
- C. Field erection of the trusses, including items such as handling, safety precautions, and temporary bracing to prevent toppling or the domino effect on the trusses during erection, and any other safeguards or procedures consistent with good workmanship and good building erection practices, shall be employed.
- D. During the entire construction period, all contractors shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any one truss and/or other component is not exceeded.
- E. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads. Provide all permanent bracing necessary for truss stability. Where sheathing is not attached directly to truss bottom chord and where required by design, provide bottom chord bracing and bridging as required to resist wind uplift loads.
- F. Frame openings between trusses with lumber in accordance with Section 06 11 00–Wood Framing and Sheathing.

END OF SECTION

SECTION 06 60 12

LAUNDER COVER SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing and installing a launder cover system over the secondary clarifier effluent troughs as shown on the drawings and specified herein. The launder covers and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Shop Drawings: As a minimum, the following shall be included in the shop drawing submittal:
 - 1. Manufacturer’s catalog information, descriptive literature, specifications and identification of materials of construction, including resins and glass fiber content and layout for FRP constructions.
 - 2. Detailed drawings showing equipment fabrication, dimensions, method of attachment including number, locations, and size and type of fasteners and weights of fabrications.
 - 3. Manufacturer’s recommended cover dimensions, mounting configuration, and location for each application.
- B. Quality Control Submittals:
 - 1. Manufacturer’s Certificate of Compliance.
 - 2. Shipping, storage, and protection and handling instructions.
 - 3. Manufacturer’s installation instructions.
 - 4. A list of five installations of comparable size in operation for at least three years.
 - 5. Certified test reports of the physical and mechanical properties of the product. Each panel shall have the following minimum physical properties:

Property	Minimum Value	Standard Test
Tensile Strength	18,000 psi	ASTM D-638
Flexural Strength	25,000 psi	ASTM D-790
Flexural Modulus	1,160,000	ASTM D-790
Barcol Hardness	45	ASTM D-2583
Notched Izod Impact	10 ft lbs/in	ASTM D-256
Water Absorption	0.1%@24 hours	ASTM D-790

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with

GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2--PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and components in this section shall be the products of NEFCO, Incorporated, 8895 North Military Trail, Bldg. C, Suite 100, Palm Beach Gardens, Florida 33410, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER if the substitute is selected.
- C. The drawings and specifications were prepared based on NEFCO Incorporated. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.

2.02 DESIGN

- A. Manufacturer shall coordinate the launder cover design and installation requirements with the clarifier mechanism, scum beach, weir baffle, and launder effluent channel configurations. Locations of clarifier equipment and all necessary elevations and dimensions of the tank shall be field-verified by CONTRACTOR and coordinated with cover system manufacturer.
- B. The launder cover shall consist of a system of molded fiberglass panels that are attached together to form a continuous cover over the launder trough, weirs, and scum baffle within the treatment tank. The cover shall be designed and manufactured to inhibit incident sunlight from striking the surfaces of the launder and weir. Each cover section shall be molded of UV-protected fiberglass and shall be opaque to sunlight. Individual sections shall have a minimum of four feet in length and curved to follow the curvature of the tank. The cover shall extend over the trough, weir, and scum baffle where possible without interfering with the sweep arms or any other portions of the clarifier equipment. The cover shall be designed so that adjacent panels fit together properly and the completed cover, when installed, forms a rigid structure and has a well-engineered and professional appearance.
- C. Provision shall be made to support the Cover in such a manner that the panels are held securely in place, with the panels hinged to provide access to the launder and weir for inspection and maintenance. Neither the Cover nor the means used to support it shall interfere with effluent flow over the weir or within the trough. Cover supports shall not impede personnel from entering and traversing the launder. Cover supports that cantilever from the outer effluent launder wall without support at the weir wall are unacceptable.

- D. Launder cover panels shall have a curved or arched shape over the width of the launder trough with sufficient radius to strengthen the panel and minimize possible deflections against snow loads.
- E. The Cover shall be designed to open away from the operator and toward the center of the tank. Each Cover segment shall consist of a fixed mounting section and two cover sections, each connected to the mounting section by a continuous stainless steel hinge. The mounting section shall provide a rigid mount for the cover sections and proper fixed spacing between them.
- F. The mounting section is fastened to the weir wall with stainless steel brackets, and extends inward to a point just inboard the scum baffle. The hinged cover sections extend outward toward the outer launder wall and swing open to allow inspection and maintenance of the launder and weir. In the closed position, the cover Sections rest on an FRP support flange attached to the outer launder wall.
- G. The hinged cover sections shall also be designed such that alternating sections have integral tabs at each side which rest on the adjacent section, insuring that the seams between panels are covered and enabling the alternate panels to open independent of every other panel. Hinged cover sections shall be provided with handles and an easily opened latch mechanism to secure the cover to the support flange.
- H. Provision shall be made to support the cover in such a manner that the panels are held securely in place, with the panels hinged to provide access to the launder and weir for inspection and maintenance. Spring-loaded latch mechanisms will secure the hinged cover sections. Handles or lift rings may also be required for some panels. A means of limiting the travel of the hinged cover sections, in the form of a restraint cable or tether, may also be provided to protect against damage. Covers with inspection hatches or cleanout doors are unacceptable. Neither the cover nor the means used to support it shall interfere with effluent flow over the weir or within the trough. Covers shall not be mounted to weir plate, scum baffle or baffle brackets.
- I. Where the circumference of the trough is interrupted by the bridge support or other obstacles, a fixed panel(s) shall be installed over the trough beneath the support so that the surface of the cover is continuous around the entire tank. Provisions for special openings, removable sections, and seals for valve stems, raised scum baffle section at scum beach, or other areas, as noted on the drawings shall be provided and detailed by the manufacturer on the shop drawings.
- J. The cover system shall be designed to withstand common wind and snow loads but shall not be intended as a "walk-on" cover designed to support the weight of plant personnel. Adequate stiffeners shall be integral to each panel, but panels reinforced with balsa or foam cores are not acceptable. Print in Red on Cover: "Do not Walk or Stand on Covers."

2.03 MATERIALS

- A. Each cover panel shall be molded of fiberglass reinforced plastics (FRP). The resins and fiberglass reinforcing materials shall be consistent with the environmental conditions and structural requirements of the application.
- B. The resin shall be an industrial quality, general-purpose resin with UV suppression additives. The resin shall be pigmented so that the resulting part is opaque. The glass

reinforcement shall be chopped strand roving, with a minimum 1/2-inch strand length. Additional reinforcement in the form of stiffening ribs shall be added when necessary. The glass content of the finished laminate shall be not less than 30% by weight. The minimum thickness of each panel shall be 1/4 inch thick. The laminate shall consist of a 20 mil outer layer of marine quality white gelcoat, followed by chopped strand roving. The laminations shall be dense and free of voids, dry spots, cracks or crazes. All factory-trimmed edges shall be sanded and sealed. The finished laminate shall have a smooth, even appearance.

- C. Fasteners, handles, hinges, latches and other hardware shall be 304 stainless steel. Fixed cover section supports (at weir wall) and all other support brackets, except for support flange at wall, shall be 304 stainless steel. Support flange for hinged cover at outer tank wall shall be FRP, and shall be molded circular to the tank radius. The latch/handle shall be a spring-loaded mechanism with a positive detent positioned to indicate the closed/locked position of the handle. The latch is activated by pressing down on the spring-loaded handle and turning it. The magnetic latch is disengaged by pulling upward on the cover, ring or other fixture with sufficient force to overcome the force of the magnet.
- D. Manufacturer to provide a 304 stainless steel cover opening/lifting tool. The tool shall be of sufficient length to open a cover section from ground level.

2.04 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be type 304 stainless steel and of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3–EXECUTION

3.01 INSTALLATION

- A. The panels shall be supported at the tank wall by means of an FRP support flange that follows the curvature of the tank. This flange shall be fastened on 24-inch centers. The panels shall be supported at the weir wall with mounting brackets of stainless steel.
- B. The installation contractor shall install the cover in accordance with approved shop drawings and manufacturer's recommendations. Field modifications (cuts, copes, holes, etc.) are not allowed without the manufacturer's written.
- C. All fasteners and brackets required for the installation shall be 304 stainless steel and shall be supplied by the cover manufacturer. The support flange and weir wall brackets shall be installed as recommended by the cover system manufacturer and as shown on the drawings.

END OF SECTION

SECTION 06 61 14

FIBERGLASS WEIRS AND BAFFLES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Fiberglass weirs and baffles as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/AWWA F101–Contact-Molded, Fiberglass-Reinforced Plastic Wash Water Troughs and Launderers.
- B. ANSI/AWWA F102–Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets.
- C. ASTM D570–Standard Test Method for Water Absorption of Plastics.
- D. ASTM D638–Standard Test Method for Tensile Properties of Plastics.
- E. ASTM D790–Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D2583–Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- G. NSF/ANSI 61 Drinking Water System Components–Health Effects.

1.03 QUALITY ASSURANCE

- A. Manufacturer shall maintain a continuous quality control program and shall, upon request, furnish ENGINEER with certified test reports of physical properties
- B. Weir plates, scum baffles, and mounting brackets shall be fabricated to ANSI/AWWA F102 Standards.

1.04 PACKING AND STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent warpage or distortion.
- B. Troughs should be stored on a flat place and adequately supported on wooden support members to evenly distribute weight of troughs. When stored more than one high, succeeding items should be stored level and evenly supported by blocks or spacers.

PART 2-PRODUCTS

2.01 WEIRS AND BAFFLES

- A. Weirs and baffles shall be fiberglass.
- B. Fiberglass shall be as manufactured by NEFCO Incorporated, or equal. All fasteners and anchors shall be type 304 stainless steel of size and type recommended by manufacturer of weirs and baffles.
- C. The weirs, scum baffles and supports shall be polyester plastic resin, reinforced with glass fiber. All weir plates, weir washers, weir splice plates, scum baffle panels, scum baffle splice plates and baffle support brackets shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces. The surface shall be resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and UV protection. All edges shall be sealed in the mold. The weirs and scum baffles shall be green in color.
- D. Laminate will have Type "C" (chemical) glass surfacing mat, 10 to 20 mils thick, with a silane finish and a styrene soluble binder, on both sides. Required thickness will be achieved using the appropriate number of piles of Type "E" (electrical borosilicate) glass mat with chrome or silane finish and a styrene soluble binder. Glass content of laminate will be 28 ± 3% by weight. Resin filters shall be 40 ±2% of the resin mixture. Final laminate thickness shall be within ±10% of the nominal specified thickness.
- E. The fiberglass laminate shall have the following minimum physical properties:

		Test Method
Tensile Strength (min)	14,000 psi	ASTM D638
Flexural Strength (min)	25,000 psi	ASTM D790
Flexural Modulus (min)	1.0 x 10 ⁶	ASTM D790
Impact, Notched, Izod, foot pound per inch (min)	15.0	ASTM D256
Barcol Hardness (min avg)	40	ASTM D2583
Water Absorption, % 24 hours (max)	0.2%	ASTM D570
Average Coefficient of Thermal Expansion inch per inch per °F (max)	10.5 x 10 ⁻⁶	ASTM D696

- F. All machined or cut edges shall be sealed with Polyester Resin.
- G. Materials:
 - 1. Resin: The resin shall be a commercial grade general purpose polyester thermosetting resin which has either been evaluated in laminate or which has been determined by a previous documented service to be acceptable for the service conditions.
 - 2. The resin shall contain no fillers except as follows:
 - a. A thixotropic agent which does not interfere with laminate quality or with the required chemical resistance of the laminate may be added for viscosity control.
 - b. Resin may contain pigments, dyes, or colorants which have been determined by at least 5 years previous service to be acceptable for the service condition without fading or chalking from original color standard.
 - 3. Ultraviolet Resistance: Ultraviolet resistance is required in all laminates exposed to ultraviolet light whether it be in the form of pigmentation or ultraviolet absorbers.

4. Metal Reinforcement: When metal reinforcements are used, they shall be free of rust, oil, and any foreign matter. They shall be completely encapsulated with a minimum of 1/8-inch-thick laminate.
5. Glass reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be Type C, 10 to 20 mil thick, with a silane finish and a styrene-soluble binder. The glass content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to the following:

	ASTM Test Method	For 1/4-IN Wall Thickness
Ultimate Tensile Strength psi x 10 ³ (min)	D638	12
Flexural Strength psi x 10 ³ (min)	D790	19
Flexural Modulus of Elasticity psi x 10 ³ (min)	D790	0.9
Barcol Hardness (min)	D2583	35
Water Absorption-% (max)	D570	0.2

H. Manufacture:

1. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Lamination shall be dense and without voids, dry spots, cracks, or crazes.
2. The inner surface of the trough shall be reinforced with glass surfacing mat. This shall be followed with chopped strand glass laminate (maximum two ounces per square foot) in a minimum of two layers. Void content of the complete laminate shall not exceed 2 1/2% of laminate volume.
3. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8 inch (measured when the trough is not loaded). The length of a trough section shall have a tolerance of ±1/8 inch per 10-foot length. The laminate thickness tolerance shall be ±1/8 inch thick.
4. Thickness at locations of supports such as saddles shall be at least 1 1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of this specification.
5. End flanges and blind ends shall be a minimum of 1 1/2 times the nominal thickness of the trough and shall conform to the fiber stress limitations set forth in the design section of this specification.
6. An integrally molded waterstop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.
7. One-inch-diameter ABS spreaders shall be bolted between the trough walls on approximate 2-foot centers to enhance the structural rigidity of the trough system.

2.02 NEOPRENE GASKETS

- A. All splices and connections of weirs and troughs shall have a minimum 1/4 inch thick, or as noted on drawings, neoprene gasket in accordance with these specifications.

PART 3-EXECUTION

3.01 INSTALLATION

- A. All trough mounting brackets, hardware, and stabilizers shall be Type 316L stainless steel and shall be supplied by the trough manufacturer.
- B. Install weirs and baffles in accordance with details shown on the drawings using Type 316L stainless steel or fiberglass connection hardware.
- C. Troughs, weirs, and scum baffles shall be installed level to within $\pm 1/8$ inch.
- D. Troughs shall be watertight.
- E. All weir and trough splices and connections shall be watertight. Provide neoprene gaskets between all splices and connections to provide complete watertight unit. Provide splice plates as required.

END OF SECTION

SECTION 07 21 12

BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor-slabs on-grade.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

2.01 CAVITY WALL INSULATION

- A. Cavity wall insulation shall be 3-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 19.0.
- B. Acceptable products include the following, or equal. DOW Thermax by DOW Corporation.
- C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

- A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0.
- B. Acceptable products include the following, or equal:
 - 1. Styrofoam Square Edge by Dow Chemical Company.
 - 2. Foamular 250 by UC Industries, Inc.

PART 3–EXECUTION

3.01 INSTALLATION–CAVITY WALLS

- A. Insulation shall be installed horizontally within the cavity space between masonry wythes.
- B. Take care during installation so that all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.
- C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.

- D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

3.02 INSTALLATION—FOUNDATION WALLS AND UNDER FLOORS

- A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.
- B. At perimeter frost wall foundations, insulation shall be 48 inches high and located on the inside of foundation walls.
- C. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

SECTION 07 21 13

BATT AND BLOWN-IN INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes batt insulation for attic spaces and insulation vent system between roof trusses as called for on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C665–Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

PART 2–PRODUCTS

2.01 EXTERIOR WALL AND ROOF INSULATION

- A. Batt insulation placed on top of ceiling panel in attic spaces shall be unfaced fiberglass batt 12 inches thick conforming to ASTM C665, Type 1, and providing a minimum R-value of 38. Two layers of 6-inch batt placed perpendicular to each other may be used in place of one layer of 12-inch batt.
- B. All batt insulation in attic spaces shall be unfaced or foil-reinforced kraft-faced meeting the 2017 Ohio Building Code or governing local building code requirements.
- C. Acceptable manufacturers include the following, or equal:
 - 1. Owens Corning.
 - 2. Manville.
 - 3. Certainteed.

2.02 INSULATION VENTS

- A. Insulation vents shall be 2 inches high by 14 inches wide by 48 inches long, tear-resistant high-impact plastic as manufactured by proVent, or equal.

PART 3–EXECUTION

3.01 INSTALLATION–ROOF INSULATION

- A. Prior to installing insulation, vapor barrier shall be in place (See Section 07 26 00–Vapor and Air Barrier).

- B. Insulation shall be loose laid on the ceiling panel over the vapor barrier. If two layers of insulation are used to make up the required thickness, upper layer shall be installed perpendicular to the lower layer.

3.02 INSULATION VENTS

- A. Insulation vents shall be installed between roof trusses at the truss bearing ends providing an unobstructed air channel from the soffit into the attic.

END OF SECTION

SECTION 07 26 00

VAPOR AND AIR BARRIER

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes:
 - 1. Vapor barrier under concrete floors on grade, in exterior construction, and on top of precast roof plank.
 - 2. Air barrier in masonry double wythe walls on concrete block backup wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Vapor barrier for below slabs: Vapor barrier shall consist of 10 mil ASTM E1745 Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- B. Permeable air barrier for masonry cavity wall construction shall be fluid applied membrane, ExoAir 230 by Tremco, or equal. Apply to outside face of inner wythe of concrete block prior to installation of rigid insulation. Apply in strict accordance with manufacturer's instructions. Air barrier shall be included in all new cavity wall construction on the project.

PART 3—EXECUTION

3.01 INSTALLATION—UNDER CONCRETE FLOORS ON GRADE

- A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.
- B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on the drawings.

3.02 INSTALLATION ON ROOF CONSTRUCTION

- A. Provide continuous vapor barrier on underside of roof framing.

3.03 INSTALLATION OF AIR BARRIER

- A. Install air barrier on outside face of inner wythe of concrete block in cavity wall construction.
- B. Install air barrier per manufacturer's recommendations and approved details.

END OF SECTION

Section 07 26 00-1

4640.003/1-2021

SECTION 07 61 00
SHEET METAL ROOFING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Standing Seam Metal Roof System.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653–Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. SMACNA–Architectural Sheet Metal Manual.
- C. NRCA–Roofing and Weatherproofing Manual (including construction details) and Handbook of Accepted Roofing Knowledge.
- D. Manufacturer’s Handbook of Construction Details.
- E. AISI “Specifications for the Design of Light–Gauge Cold Formed Steel Structural Member, latest edition.”

1.03 SUBMITTALS

- A. See Section 01 33 00–Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.
- C. Samples: Submit one sample of each type of prefinished and preformed panel showing color and profile match. Provide same for closures.
- D. Warranty from manufacturer: Submit sample of manufacturer’s 20-year warranty on weather tightness, flashing, inclusive.

1.04 QUALITY ASSURANCES

- A. Perform work in accordance with manufacturer’s instructions and these specifications.

1.05 QUALIFICATIONS

- A. Material Manufacturer: Five years documented experience with this type of construction.
- B. Installer: Five years of satisfactory documental experience in the installation of this type of work.

1.06 WARRANTIES

- A. Architectural finish coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.
- B. Warrant materials and workmanship for 20 years for weather tightness, flashing, inclusive.

1.07 SYSTEM DESIGN

- A. All components of the paneling system shall be designed in accordance with sound engineering methods and practices.
- B. The panels shall be designed in accordance with AISI "Specifications for the Design of Light Gauge Cold Form Steel Structural Members," latest edition.
- C. The paneling system and its attachments shall be designed to support live, snow, and wind loads.
- D. The panel shall not be considered a safe work platform until completely secured to the structural system. Therefore, walk boards or other safety equipment, as required by safety standards, shall be provided by the erecting contractor to provide worker safety during panel installation.
- E. Panels shall be designed for 20 psf live load.
- F. The roof system shall carry UL wind-uplift Class 90 rating.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Metal Roof System:
 - 1. Roof panels shall be roll formed panels of uniform width 12 to 18 inches wide with two major corrugations, 2 1/2 inches high, 16 inches (equal to panel width) on center.
 - 2. Panel materials shall be 24 gauge, hot-dipped galvanized steel (50,000 psi yield), G-90 coating conforming to ASTM A653 specification.
- B. Fasteners:
 - 1. All connections of panels to structural members, except at eave, shall be made with clips with moveable tabs that are seamed into the standing seam side lap.
 - 2. Panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings.
 - 3. Panel-to-panel connections shall be made with a positive, field-formed standing double-lock seam, formed by a special seaming device.
- C. Underlayment and Eave Protection Membrane:
 - 1. Underlayment for all areas, except along eaves, shall be No. 30 unperforated asphalt saturated felt conforming to ASTM D226.
 - 2. Eave (ice dam) protection applied to 4 feet inside the exterior wall line eaves shall be a sheet membrane of rubberized asphalt bonded to sheet polyethylene, 40 mils minimum

total thickness, with strippable release paper. Acceptable products include the following, or equal:

- a. Ice and Water Shield by W.R. Grace Company.
- b. Winter Guard Waterproofing Shingle Underlayment by Certainteed Corporation.

2.02 MANUFACTURERS AND PRODUCTS

- A. Roof panels shall be roll-formed Stand N' Seam panels as manufactured by Fabral, or equal.
- B. Sealants: Per Section 07 90 00—Caulking and Sealants.
- C. Flashing at eave, gable, ridge, and penetrations shall be in accordance with manufacturer's recommendations and Section 07 62 00—Flashing and Sheet Metal.
- D. Unless shown otherwise on the drawings, provide continuous ridge venting using manufacturer's standard ridge/hip flashing and manufacturer's approved detail. Provide vent material to prevent entry of insects.
- E. Unless shown otherwise on the drawings, provide snow guards on the roof above all exterior door openings, extending minimum 1 foot beyond each edge of door. Snow guards shall consist of a snow bar mounted to a nonpenetrating clamp attached to the standing seam ribs. Snow bar shall incorporate a prepainted metal strip to match the roof panel color. Acceptable products include Color Guard Snow Guard with prepainted insert and S-5-U clamps by LM Curbs, Longview, Texas, or equal.

2.03 FINISHES

- A. Finishes on all exterior surfaces shall be a 1.0 mil DFT two-coat, factory-applied, 70% Kynar, 500 fluoropolymer coating over an epoxy prime coat.
- B. All exposed fasteners shall be provided with the same finish as the sheet material products.
- C. Colors shall be selected by OWNER.

PART 3—EXECUTION

3.01 INSTALLATION

- A. The panels shall be attached to the supporting structurals by means of a clip device. The clip shall occur at the panel major corrugation.
- B. Panel sidelaps shall be field-seamed by a seaming device; all sidelap sealant shall be factory-applied.
- C. Panel endlaps, when required, shall be at least 6 inches and sealed with field-applied sealant. One panel end shall be "swaged" to provide nestible, watertight endlaps.
- D. Provisions for thermal expansion/contraction movement of the panel shall be accomplished by the use of clips with a moveable tab. The tabs shall be factory-centered on the roof clip to provide full movement in either direction.

- E. The roof shall provide for thermal expansion/contraction without detrimental effect on the roof panel when there is a 100°F temperature differential between the interior structural framework of the building and the roof panels.

END OF SECTION

SECTION 07 62 00

FLASHING AND SHEET METAL

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes masonry wall flashing, custom-fabricated sheet metal flashing and counter flashing at: Eave, gable, and ridge lines; vent stacks; and other locations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653–Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- B. ASTM A924–General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
- C. ASTM B32–Solder Metal.
- D. ASTM B209–Aluminum and Alloy Sheet and Plate.
- E. ASTM D4586–Asphalt Roof Cement, Asbestos-Free.
- F. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. See Section 01 33 00–Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

1.05 QUALIFICATIONS

- A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of 5 years of verifiable experience in that field.

1.06 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.
- B. Galvanized Steel Sheet: 26 gauge meeting ASTM A525, Grade A with G90 zinc coating.
- C. Aluminum Sheet: 0.032 inches thick meeting ASTM B209.
- D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Bituminous type.
- G. Sealant: See Section 07 90 00-Caulking and Sealants.
- H. Bedding Compound: Rubber asphalt or butyl type.
- I. Plastic Cement: ASTM D4586, Type I or II.
- J. Reglets: Galvanized steel or PVC, surface-mounted or recessed, or as shown on the drawings.
- K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

2.02 FABRICATION

- A. All flashing and fascia shall be formed to the configurations shown on the drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the drawings, or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.
- B. All exposed edges shall be folded or returned on themselves at least 1/2 inch. Corners shall be mitered and seamed.
- C. Form pieces in the longest possible lengths. Form material with flat lock seams.
- D. All sections shall be provided with slip joints at 8 feet on center.
- E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form a drip.

- G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

2.03 FINISH

- A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.
- B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09 91 00–Painting. Aluminum shall be coated with a Kynar 500 coating system.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Through-wall flashing shall be installed 1/2 inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.
- B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.
- D. Insert flashings into reglets where shown on the drawings. Seal flashings into reglets with sealant.
- E. Counter flashing shall be provided at all vertical masonry and/or concrete walls which extend above the roof line. The counter flashing shall be installed in a reglet unless otherwise shown. Surface-mounted reglets shall be used where noted.
- F. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

SECTION 07 71 00

MANUFACTURED ROOF SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Metal fascia and soffit.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. Submittals shall comply with requirements of Section 01 33 00–Submittals.
- B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details.

1.05 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2–PRODUCTS

2.01 FASCIA

- A. Metal fascia system shall be constructed of 24 gauge galvanized steel and shall include all necessary angles, clips, corners, and other accessories of the same material as the finish panels.
- B. Acceptable products include the following, or equal: Fascia System by Fabral, Peterson Aluminum Corporation, and shall be made by the same manufacturer as the sheet metal roofing in Section 07 61 00.

2.02 SOFFIT

- A. Metal soffit system shall be constructed of 0.032-inch-thick aluminum sheet and shall include all necessary channels, angles, clips, flashing, fasteners, and other accessories of the same material as the soffit panels. Soffit panels shall be fully vented to allow for ventilation and shall have stiffener grooves spaced at 6 inches on center.

- B. Acceptable products include the following, or equal: Fabral, PAC 750 by Peterson Aluminum Corporation, and shall be made by the same manufacturer as the sheet metal roofing in Section 07 61 00.

2.03 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install components in accordance with the drawings and the manufacturer's instructions.
- B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

SECTION 07 71 23

GUTTERS AND DOWNSPOUTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aluminum gutters and downspouts.
 - 2. Precast concrete splash pads.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B209–Aluminum and Aluminum Alloy Sheet and Plate.
- B. SMACNA–Architectural Sheet Metal Manual.

1.03 DESIGN REQUIREMENTS

- A. Conform to SMACNA manual for sizing components for a 10-year storm event.

1.04 REGULATORY REQUIREMENTS

- A. Conform to the 2017 Ohio Building Code or governing local building code for size and method of rainwater discharge.

PART 2–PRODUCTS

2.01 GUTTERS AND DOWNSPOUTS

- A. Gutters and downspouts shall be constructed of 0.032-inch-thick aluminum sheet conforming to ASTM B209 and shall be made from the same manufacturer as the fascia and soffit system.

2.02 ACCESSORIES

- A. Anchorage devices shall meet SMACNA or manufacturer's requirements.
- B. Gutter supports shall be straps and fasteners at maximum 3 feet 0 inches on center.
- C. Downspout supports shall be brackets of the appropriate size and spacing.
- D. Fasteners shall be aluminum or stainless steel.

2.03 SPLASH PADS

- A. Splash pads shall be precast concrete of the appropriate size with minimum 28-day compressive strength of 3,000 psi and minimum 5% air entrainment.

2.04 FABRICATION

- A. Form gutters and downspouts to SMACNA requirements.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion by providing expansion joints as required.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.05 FINISHES

- A. Finish on gutters and downspouts shall match finish on fascia system. All components, including fasteners and supports, shall be prefinished to match gutters and downspouts.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install gutters, downspouts, and accessories with manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Install gutters level.
- D. Seal metal joints watertight.
- E. Set splash pads under downspouts.

END OF SECTION

SECTION 07 90 00
CAULKING AND SEALANTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C920–Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01 33 00–Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.
- C. Submit copies of warranty.

1.04 WARRANTY

- A. Caulked joints shall be weathertight and guaranteed watertight by installer for two years from the earlier of either the date established for partial utilization in accordance with GC-15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project. Deliver original guarantee to OWNER with copies to ENGINEER.

PART 2–PRODUCTS

2.01 CAULK–NONSUBMERGED APPLICATIONS–GENERAL

- A. Caulk for nonsubmerged applications in all locations except floor joints shall be a one-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
 - 1. Masterseal NP1 by Master Builders Solutions.
 - 2. Vulkem 116 by Tremco, Inc. (exterior applications only).
 - 3. Dymonic 100 by Tremco, Inc.

2.02 CAULK–NONSUBMERGED APPLICATIONS–FLOOR JOINTS

- A. Caulk for floor joints in nonsubmerged applications shall be a one-part, self-leveling, polyurethane sealant.

- B. Acceptable products include the following, or equal:
 - 1. SL1 by Master Builders Solutions.
 - 2. Vulkem 45 SSL by Tremco, Inc.

2.03 CAULK–SUBMERGED APPLICATIONS

- A. Caulk in all submerged applications shall be an NSF/ANSI Standard 61-approved two-part, polysulfide base synthetic rubber sealant.
- B. Acceptable products include the following, or equal:
 - 1. Thiokol 2235M by PolySpec.
 - 2. Sika Duoflex NS by Sika Corporation.

2.04 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.
- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.
- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2-inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.

- D. Backer rod shall be used in all openings 3/4 inches or more in depth and shall be tightly packed to completely fill the space to 1/2-inch back of face. The 1/2-inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.
- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weathertight condition.

END OF SECTION

SECTION 08 11 00

STANDARD STEEL DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Thermally-insulated and fire-rated steel doors and frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/SD1-100–Standard Steel Doors and Frames.
- B. UL 10B–Fire Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

1.04 REGULATORY REQUIREMENTS

- A. Fire-Rated Door and Frame Construction: Conform to UL 10B.

PART 2–PRODUCTS

2.01 THERMALLY-INSULATED DOORS

- A. Thermally-insulated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with polyurethane core rigid reinforcing full thickness.
- B. Acceptable products include the following, or equal:
 - 1. Ceco Imperial.
 - 2. Curries 707 Series.

2.02 FIRE-RATED DOORS

- A. Fire-rated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with honeycomb or steel stiffened rib core for full thickness of door. Fire doors shall carry Underwriters label on the door.
- B. Acceptable products include the following, or equal:
 - 1. Ceco Regent.
 - 2. Curries 747 Series.

2.03 FABRICATION–DOORS

- A. Doors shall be fully-sealed, continuously-welded construction with all surface welds, joints, and seams filled and ground smooth.
- B. Tops and bottoms of doors shall be completely closed with 16 gauge channels. Outside edges of doors shall be flush without depressions. No inverted channels will be allowed.
- C. Mortise, reinforce, drill, and tap doors to receive hardware. Reinforcement shall be welded within the stiles and rails. Reinforce top rails to accommodate closers on either side and reinforce bottom for kickplate.
- D. All Underwriters fire doors shall be constructed to meet Underwriters Laboratories specific approval according to current procedure for the indicated class.
- E. Glass in exterior doors shall be 1 inch thick.

2.04 FRAMES

- A. Steel door frames shall be made of 14 gauge, cold-rolled, prime-quality steel in accordance with ANSI/SD1-100.
- B. Fire-rated frames shall carry Underwriters label on the frame.

2.05 FABRICATION–FRAMES

- A. Fabricate frames as welded unit. Weld joints continuously through full throat width of frames, including rabbets, soffits, and stops; grind, fill, dress, and make smooth, flush, and invisible.
- B. Welded frames shall be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and shall not be used to size the frame opening.
- C. Frames shall be 2 inches by 5 3/4 inches. Frames shall have 4-inch head member at 7 feet 0-inch doors in masonry walls.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. All Underwriters fire-rated frames shall be constructed to meet Underwriters Laboratories specific approval according to current procedure for the indicated class.
- F. Provide anchors appropriate to wall type.
- G. Provide frames for all steel doors.

2.06 FINISH

- A. Doors and frames shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field-paint system specified.
- B. Frames shall be finish-painted as specified in Section 09 91 00–Painting prior to installation. This includes back sides of door frames.

PART 3-EXECUTION

3.01 INSTALLATION-FRAMES

- A. Install frames in accordance with ANSI/SD1-100.
- B. Coordinate installation of frames with wall construction for anchor placement.
- C. Coordinate installation of frames with installation of doors, hardware, joint sealers, and field painting.
- D. Set all frames as supplied by manufacturer.
- E. Frames in masonry walls shall be grouted full.

3.02 INSTALLATION-DOORS

- A. Install doors in accordance with ANSI/SD1-100.
- B. Coordinate installation of doors with installation of frames, hardware, glass and glazing, and field painting.
- C. Set all doors as supplied by manufacturer. Hang all doors allowing for expansion and contraction at time of setting.
- D. Set all hardware in accordance with templates as supplied by hardware supplier.
- E. Cover all exposed hardware until completion of painting and finishing.
- F. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.

3.03 SCHEDULE

- A. See Door Schedule on drawings.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Aluminum floor doors and frame units.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

2.01 ALUMINUM FLOOR DOORS AND FRAMES

- A. Acceptable products include the following, or equal: The Bilco Company, Types K or J as scheduled.
- B. Type J doors shall be designed for a minimum live load of 300 psf with a maximum deflection of 1/150 of span. Type K doors shall be designed for minimum live load of 150 psf with a maximum deflection of 1/150 of span.
- C. Doors shall be constructed of stiffened 1/4-inch aluminum diamond-pattern plate.
- D. Channel frame for Type J doors shall be 1/4-inch extruded aluminum with bend-down anchor tabs. Depth of frame shall be 6 inches. A continuous EPDM gasket shall be mechanically attached to the frame around the entire perimeter.
- E. Hinges shall be through bolted to the door and frame with tamper-proof Type 316 stainless steel lock bolts.
- F. Provide 1 1/2-inch drain coupling located in corner of channel frame for Type J doors.
- G. Type J doors shall be equipped with required number and size of compression spring operators for door to operate easily and smoothly. Provide heavy-forged cam-action hinges to open door so edge of door does not open into channel. Type K doors shall have cast steel cam-action hinges that pivot on torsion bars. Doors shall have smooth controlled operation and not be affected by temperature.
- H. Provide hold-open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.

2.02 FINISH

- A. Aluminum floor doors and frames shall have mill finish. Apply bituminous coating to portions of frames in contact with concrete.

- B. Steel access doors shall have shop-applied prime coat compatible with field paint system specified.

2.03 ACCESSORIES

- A. Provide Bilco Ladder-Up, or equal, at all floor doors that have a ladder access. Materials and finishes shall be aluminum, mill finish.
- B. All aluminum floor/door openings shall be fitted with a permanently installed, fall-through prevention grating system that is easily retractable for access to the opening below. Grating system shall be factory installed by access door manufacturer.
- C. Performance Characteristics:
 - 1. Grating panel(s) shall be high visibility safety yellow in color.
 - 2. Grating panel(s) shall lock automatically in the full open position.
 - 3. Grating system shall have a twenty-five year warranty.
 - 4. Grating panel(s) shall have a provision for locking to prevent unauthorized opening.
- D. Grating: Panels shall be aluminum with a powder coat paint finish and designed to meet OSHA 1926.502(c) and 1910.29 requirements for fall protection.
- E. Hold Open Feature: A Type 316 stainless hold open device shall be provided to lock the cover in the fully open 90 degree position.
- F. Hardware: All hardware shall be Type 316 stainless steel.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
- B. Provide piping from channel frames for Type J floor doors from outlet to base of wall nearest floor drain or through wall to ground for tank structures. Terminate pipe in minimum 1 cubic foot of clear stone if termination is below ground.

3.02 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer that will not damage finish.
- B. Test units for proper function and adjust until proper operation is achieved.
- C. Repair finishes damaged during installation.
- D. Restore finishes so no evidence remains of corrective work.

3.03 SCHEDULE

- A. See Door Schedule on the drawings.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hardware to fully equip all doors.
 - 2. Thresholds and weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 80–Fire Doors and Windows.

1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the 2017 Ohio Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.
- B. Hardware for Structure 30 Building shall comply with barrier-free requirements.

PART 2–PRODUCTS

2.01 LOCKSETS AND LATCHSETS

- A. Locksets and latchsets shall be Corbin Russwin Large Format Interchangeable Cores, no equal.
- B. Locksets and latchsets shall have 2 3/4-inch backset. Strikes shall be curved lip.
- C. Lockset and latchset numbers listed in Paragraph 3.02 Schedule are Sargent or Accurate (listed first) followed by Schlage or Schwepper number (listed second in parentheses).
- D. Provide removable core brass 6- or 7-pin cylinders for all locksets and latchsets.

2.02 EXIT DEVICES

- A. Exit devices shall be Sargent 8813 x ETL Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a lockable lever from the exterior side.

2.03 HINGES

- A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonrising, loose pin, and flat bottom tip, unless otherwise specified. Provide

three 4 1/2-inch by 4 1/2-inch hinges per door for doors 7 feet or less in height with one additional hinge for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional hinges or heavyweight hinges for all doors that are over 36 inches wide, unless specified otherwise.

2.04 DOOR CLOSERS

- A. Door closers shall be LCN Series 1460 for exterior doors. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in paragraph 3.02 are LCN. (H-Hold Open).

2.05 OVERHEAD DOOR HOLDERS

- A. Overhead door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in paragraph 3.02 are Glynn Johnson.

2.06 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal.

2.07 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

2.08 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, or GJ60W for locations noted as (ss), or equal.

2.09 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with Reese DS75, National Guard Products, Inc. 156, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S425A, Pemko 171A (provide Reese S439A, Pemko 273A, for areas with thicker flooring on one side), or equal, thresholds. Exterior doors without mullion shall have Reese No. 87, Pemko 352A, or equal, positive sealing astragal.

2.10 KEYING

- A. Door keys shall be keyed alike. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion. Doors shall be keyed to match the Waynesville Regional WWTP.

2.11 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in paragraph 2.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.

- C. Where stainless steel (ss) is specified, all hardware, including threshold and weatherstripping, shall be installed with stainless steel fasteners.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

3.02 SCHEDULE

- A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

Group 1

EXTERIOR DOOR US26D
SARGENT (SCHLAGE)

Lockset-10G05 (ND92PD)
Door Closer-1460H
(Parallel Arm)
Hinges and Kickplate

Group 2

INACTIVE EXTERIOR DOOR

Surface bolts-One top and bottom
Overhead Door Holder GJ 81 H-HD
Hinges and Kickplate

Group 3

BATHROOM PRIVACY LOCK
SARGENT (SCHLAGE)

Lockset 10U65 (ND40S)
Hinges

Group 4

ELECTRICAL ROOM

Exit Device 8813 X ETL
Door Closer-1460 BF (Regular arm)
Hinges and Kickplates

END OF SECTION

SECTION 08 81 00

GLAZING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes glass and glazing for windows and door lights.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. GANA–Glass Association of North America.
- B. NFPA 257–Standard on Fire Test for Window and Glass Block Accessories.
- C. NFPA 80–Standard for Fire Doors and Other Opening Protectives.
- D. UL 9–Standard for Safety Fire Tests of Window Assemblies.

1.03 WARRANTY

- A. Exterior insulating glass shall be provided with a 10-year warranty against failure of the seal.
- B. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

PART 2–PRODUCTS

2.01 EXTERIOR GLASS

- A. Glass in exterior metal windows and exterior door lights shall be 1-inch-thick insulating glass consisting of two pieces of 1/4-inch float glass separated by a 1/2-inch air space.
- B. Acceptable manufacturers include the following, or equal: Oldcastle Glass Company, PPG Solarban 70XL.
- C. Glass shall be Low-E with clear tint outboard light and clear tint inboard light with the following maximum values, or equal.

	Shading Coefficient	U-Value		SHGC
		Winter	Summer	
Clear	.32	.28	.26	.27

- D. Exterior windows adjacent to doors and exterior door lights shall have tempered glass in compliance with the governing building code.

2.02 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.
- B. Acceptable products include the following, or equal:
 - 1. Tremco Vision Strip System.
 - 2. General Electric Silglaze.

2.03 FABRICATION

- A. Glazing of windows shall be from the interior.
- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Comply with "Glazing Manual" by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes gypsum wallboard, accessories, and texture finish.
- B. Related Sections: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C475–Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- B. ASTM C840–Standard Specification for Application and Finishing of Gypsum Board.
- C. ASTM C1396–Standard Specification for Gypsum Board.
- D. ASTM E119–Standard Test Methods for Fire Tests of Building Construction and Materials.

1.03 REGULATORY REQUIREMENTS

- A. Conform to the 2017 Ohio Building Code for fire-rated assemblies.

1.04 ENVIRONMENTAL CONDITIONS

- A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.
- B. For nonadhesive attachment of gypsum board to framing, maintain not less than 40°F. For adhesive attachment and finishing of gypsum board, maintain temperature uniformly within the range of 55°F to 70°F for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove moisture not required for drying joint treatment materials. Avoid drafts during dry hot weather to prevent materials from drying too rapidly.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
 - 1. United States Gypsum Company (USG).
 - 2. Gold Bond Building Products Division, National Gypsum Company.

2.02 MATERIALS

- A. Gypsum Wallboard-Interior Sheathing:
 - 1. Provide gypsum board conforming to ASTM C1396, in maximum lengths available to minimize end-to-end joints.
 - 2. Gypsum shall be 5/8-inch-thick by 48-inch-wide USG Sheetrock SW Gypsum Panels, Gold Bond Sta-Smooth Gypsum Wallboard, or equal.
 - 3. Provide moisture-resistant gypsum wallboard on the walls in the restrooms, USG Fiberock Aqua-Tough Interior Panel, 5/8 inches thick.
 - 4. Gypsum board for fire-rated walls shall be 5/8-inch USG Sheetrock Firecode C core gypsum panels, or equal.

- B. Accessories:
 - 1. Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
 - 2. Reinforcement at exterior corners shall be USG Galvanized Dura-Bead No. 101, Gold Bond Standard Cover Bead, or equal.
 - 3. Reinforcement at internal corners shall be USG No. 100 Perf-a-Tape, Gold Bond Joint Tape, or equal.
 - 4. Provide trim accessories as required.
 - 5. Provide No. 200 case beads and other accessories as detailed or required.
 - 6. Joint compound shall be USG Durabond 90, Gold Bond Sta-Smooth, or equal, at cased edge joints.

- C. Finish Materials: Interior textured finish shall be USG Spray Texture Finish; Gold Bond Spray Quick, medium-fine finish, or equal.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine substrate to receive gypsum wallboard systems for alignment, support, bracing, etc., prior to installation. Shim, block as required to comply with tolerances.

- B. Verify that the installation of all blocking, mechanical, and electrical work is completed.

3.02 INSTALLATION

- A. Install and finish gypsum board to comply with ASTM C840.

- B. Direct Attachment:
 - 1. All ends and edges of sheetrock shall occur over nailing members except when joints are at right angles to framing members.
 - 2. All wallboards shall be applied horizontally. All ends and edges shall fit neatly. End joints shall be staggered. Joints on opposite sides of a partition shall be arranged to occur on different studs.
 - 3. Sheetrock shall be applied to studs by power-driven 1 1/4-inch Type W screws, spacing not to exceed 12 inches on center.
 - 4. Fasteners shall be at least 3/8 inches from edges.

- C. Direct Furring Channel Attachment:
 - 1. Apply gypsum panels horizontally (right angles to framing). Use maximum practical lengths to minimize end joints. Fit ends and edges closely, but not forced together. Stagger end-joints in successive courses. When necessary, cut ends, edges, and cutouts within the field of the panel in a workmanlike manner.
 - 2. Drive fasteners in field of panel first working toward ends and edges. Hold panel in firm contact with framing while driving fasteners. Space perimeter fasteners at least 3/8 inches from ends and edges.
 - 3. Attach gypsum panels to framing supports by power-driven USG brand screws, Gold Bond 1 1/4-inch Type A drywall screws, or equal, spaced 12 inches on center maximum.
- D. Cut openings required for ducts, piping, etc., above ceiling or fit panels after installation.
- E. Provide edge trim at all exposed edges of board and where board abuts dissimilar material. No raw drywall shall abut another material without a bead.
- F. Treat cut edges and holes in moisture-resistant gypsum board with sealant.
- G. Provide control joints at locations indicated or, if not indicated, at spacings and locations required by referenced gypsum board application and finish standard to prevent cracking of finished drywall.
- H. Patch all existing areas that are modified or damaged.

3.03 JOINT TREATMENT

- A. Finish all exposed-to-view surfaces.
- B. Reinforce and trim all joints, vertical and horizontal corners, and exposed edges.
- C. Fill with finishing compound all joints, fastener heads, trim accessory flanges, and other depressions in the surface of the wallboard to obtain a smooth flush surface.
- D. Prefill all V-grooved SW board. Butter all joints. Embed tape and apply skim coat of joint compound.
- E. Do not use topping compound for embedding tape.
- F. Do not intermix joint compounds.
- G. Spot fastener heads and fill beads and trim.
- H. Apply second and third coats.
- I. Allow drying time between application of joint compound in accordance with manufacturer's recommendations for the relative humidity and temperature levels at the time of application. In no case, allow less than 24 hours drying time between applications of joint compound.
- J. Lightly sand joint compound smooth between coat applications.
- K. Apply not less than three separate coats of joint compound over joints, fastener heads, and metal flanges on surfaces exposed to view.

- L. Where not exposed to view within building, embed tape at joints and skim coat with joint compound.
- M. Finishing work will not be considered acceptable if corners of edges do not form true, level, straight, or plumb lines, or if joints, fasteners, head, flanges of trim accessories, or defects are visible after application of field-applied decoration.

3.04 TEXTURE FINISH

- A. All sheetrock shall be sprayed with a single coat of texture finish.
- B. Apply finish to an area of approximately 200 square feet and obtain OWNER's approval. Approved area shall establish standard for all the work.
- C. Protect adjacent surfaces from texture droppings or overspray.
- D. The spray shall be uniform and free from application patterns.
- E. The spray equipment shall be of such a size and type to provide acceptable results.
- F. Apply at a minimum rate of 200 square feet per gallon.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM B117–Standard Practice for Operating Salt Spray (Fog) Apparatus.
- B. ASTM D2247–Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity.
- C. ASTM D3363–Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM D4060–Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541–Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585–Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- G. SSPC–The Society for Protective Coatings–Steel Structures Painting Manual.
- H. NACE–National Association of Corrosion Engineers.
- I. ICRI–International Concrete Repair Institute.
- J. Federal Register–Code of Federal Regulations (CFR).
- K. Federal Register–Resource Conservation and Recovery Act (RCRA).
- L. Federal Register–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

- C. Submit two copies of manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in paragraph 2.01.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
 - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
 - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
 - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
 - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
 - 2. One wet-film thickness gauge.
 - 3. One dry-film thickness gauge, Mikrotest III, 0-40 mils with calibration standard approved by the Bureau of Standards.
 - 4. One Bacharach Sling Psychrometer, Model 12-7011.
 - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
 - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.
- D. CONTRACTOR shall provide documentation to ENGINEER of conditions before and during painting operations for each area and each day's work. Documented conditions shall include the following at a minimum: date, area of work, system used, preparation methods, environmental conditions, quantity and thickness of coating placed, noted conditions, and nonconforming items. ENGINEER can provide sample report form if CONTRACTOR does not have their own.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.

- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

PART 2--PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin Williams Company, International Devoe, Carboline, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin Williams, listed in the following specifications, are set up as standard of quality. International Devoe, Carboline, and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
 - 1. Abrasion--ASTM D4060, CS-17 Wheel, 1,000 grams load.
 - 2. Adhesion--ASTM D4541.
 - 3. Hardness--ASTM D3363.

4. Humidity–ASTM D2247 and D4585.
5. Salt (Fog) Spray–ASTM B117.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

A. General:

1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03-04 Abrasive Blast Cleaning.
6. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

C. Concrete:

1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive-blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces

for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5.

3. Bug holes, pits, voids, and cracks shall be filled as specified in Section 03 30 00—Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
 4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
 5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- D. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- E. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- F. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- G. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.

3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.

- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.
- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07 90 00 requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.
- K. For PVC and CPVC piping, unions and valves shall not be painted.

3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

A. General:

1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
2. See Finish Schedule on the drawings for an additional reference for areas to be painted.
3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
4. Products listed first are Tnemec and second are Sherwin Williams.

B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
2. Interior concrete floors, including equipment bases: See Section 03 30 00 for sealed concrete floors.
3. Interior concrete block walls and concrete walls: One filler coat of Epoxoblock WB 1254, Kem Cati-Coat HS, and two coats Series N69 Hi-Build Epoxoline II, Macropoxy 646.

Note: Paint shall be roller- or brush-applied to concrete sound-absorptive block.

4. Interior concrete walls: Interior face of concrete tank walls and floors channels and pipe trenches are not to be painted.
5. Cast or ductile iron; not submerged or buried (including pipes to be insulated):

- a. One shop coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646 Beige as primer;
- b. Touch-up prime coat prior to finish coating; and apply either:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
- 6. Cast or ductile iron, tar coated; buried: Not painted.
- 7. Cast or ductile iron, submerged:
 - a. One shop coat Series 1 Omnithane (20HS or N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
 - b. Touch-up prime coat prior to finish coating and one stripe coat on all edges of N69 Epoxoline, Dura-Plate 235.
 - c. Two coats of Series 66HS-Hi-Build Epoxoline II, (one coat) Sher-Glass FF.
- 8. Steel, machinery, and equipment; not submerged (including pipes to be insulated):
 - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer.
 - b. Touch-up primer prior to finish coat, and either:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

FIRST FIELD COAT SHALL BE APPLIED PRIOR TO INSTALLATION TO SURFACES INACCESSIBLE AFTER INSTALLATION INCLUDING BACK SIDES OF DOOR FRAMES. SEE DIVISION 08 FOR FACTORY-APPLIED DOOR PRIMERS.

- 9. Motors, gear drives, and doors delivered with nonepoxy primers:
 - a. Degrease per SSPC-SP1.
 - b. Lightly hand-sand per SSPC-SP2.
 - c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.
 - d. Apply two finish coats as follows:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
- 10. Steel, machinery, and equipment, submerged:
 - a. One shop coat Series 1 Omnithane (20HS or 66HS-1255 Epoxoline), Dura-Plate 235 Beige as primer.
 - b. Touch-up prime coat prior to finish coating, and one stripe coat on all edges of N69 Hi-Build Epoxoline II, Dura-Plate 235.
 - c. Two coats of N69 Hi-Build Epoxoline II, (one coat) Sher-Glass FF.
- 11. Galvanized, copper, brass, CPVC, and PVC; not submerged or buried:
 - a. One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646, and either:
 - b. Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
 - c. One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
- 12. Insulation of equipment, pipes, and ductwork:
 - a. Two coats of Series 1029 Endurotone, DTM Acrylic B66100.
 - b. Colored PVC jacketing shall not be painted.
- 13. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
- 14. Aluminum items:
 - a. Exposed areas of structural items such as railings and grating shall not be painted.
 - b. For structural items in contact with concrete, See Division 05.

15. High temperature coatings (250°F to 500°F for steel and ductile iron piping and accessories):
 - a. One prime coat of Series 1501 Endura-Heat Primer High-Flex Hi-Temp 500 (2.0 to 3.0 DFT).
 - b. One finish coat of Series 1552 Endura-Heat, High-Flex Hi-Temp 500 (2.0 to 3.0 DFT).
16. Stainless steel: Not painted.

C. Coverage:

1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT thickness as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil** Thickness Per Coat
Products		
1029 Endurotone, DTM Acrylic B66100	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
20HS Pota-Pox, Macropoxy 646 NSF		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
1074 Endura-Shield II, Acrolon 218HS	---	2.5
201 Epoxoprime, ArmorSeal 1000 HS Epoxy	250	
280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy	250	
Epoxoblock WB 1254, Kem Cati-Coat HS	80	
N69 Hi-Build Epoxoline II, Macropoxy 646 (Masonry and Concrete)	250	
Series1 Omnithane, DuraPlate 235 (Primer)		3.0, 5.0
N69 Hi-Build Epoxoline II (Submerged)		6.0
Sher-Glass FF (Submerged)		12.0

** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or

application. Final total dry film thickness (DFT) shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

D. Pipe Colors:

1. Colors are to be selected by OWNER, with the following piping colors used where applicable.

Pipe Type	WASTEWATER PIPING COLORS
	10 States Standards (2014 Wastewater)
Raw sludge line	Gray
Sludge recirculation suction line	Brown with yellow bands
Sludge drawoff line	Brown with orange bands
Sludge recirculation discharge line	Brown
Liquid Alum	-
Alum	
Sludge	Black
Biogas	Red
Natural gas	Red
Potable water	Blue
Chlorine	Yellow
Sulfur dioxide	Yellow with red bands
Sewage (wastewater)	Gray
Compressed air	Dark Green
Instrument air	-
Heating hot water (buildings or digesters)	Blue with 6-inch red band spaced 30 inches apart
Fuel oil	Red
Plumbing drains and vents	Black
Polymer	Unpainted
Ozone	-
Nonpotable water	Purple
Raw Water	-
Effluent after clarification	-
Ferric Chloride	Orange
Ferric Sulfate	-
Electrical Conduit	-

- E. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating.
1. Fiberglass doors, equipment, structures, stairs, and railing.
 2. Hoists, trolleys, and cranes.
 3. Factory-finished HVAC equipment. Rooftop units are to be field-painted.
 4. Vertical shaft mixers.
 5. Chemical feed system pumps and accessories.
 6. Submersible pumps.
 7. Propeller submersible pumps.
 8. Screening equipment.
 9. Screenings wash press.
 10. Primary clarifiers (center pier bolt template, bottom seal ring, manifold and center pier).
 11. Scum dewatering screen.
 12. Centrifuge dewatering equipment.
 13. Trilobe positive displacement blowers.
 14. Compressed air systems (air compressors, after coolers and refrigerant dryer).
 15. High speed aeration compressor.
 16. Aeration equipment.
 17. Channel aeration equipment.
 18. Submersible mixers.
 19. Anoxic mixers.
 20. Nitrate recycle pumps.
 21. Laboratory furniture and equipment.
 22. Samplers.
 23. Furniture.
 24. Parshall flume liners.
 25. Motor control centers.
 26. Supervisory control centers.
 27. Sump pumps.

END OF SECTION

SECTION 10 14 00
PLASTIC AND METAL SIGNS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Facility sign, bronze plaque, room signs, site signs, fire wall signs, and caution signs.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign.

PART 2–PRODUCTS

2.01 FACILITIES SIGNS

- A. Shall be in accordance with the details shown on the drawings.
- B. Sign shall be Series 325 post and flush-face aluminum panel system by Charleston Industries, Inc. (800-647-2384), or equal.
- C. Post shall be extruded extended radius aluminum tubing complete with caps and a baked-enamel finish.
- D. Sign shall be constructed of aluminum panels.
- E. Lettering shall be 3 inches high, Helvetica Medium, vinyl die-cut. See drawing for layout.
- F. Color of aluminum sign and vinyl lettering will be selected by OWNER.

2.02 BRONZE PLAQUE

- A. Bronze plaque shall be 20 inches wide by 24 inches high.
- B. Raised surfaces and borders shall be satin-polished natural color. Background shall be brown-colored contrast. Plaque edges shall be single-edge bevel.
- C. Lettering shall be Helvetica Medium with a maximum number of 360 characters.

- D. Plaque will have name of project, list of officials, ENGINEER, CONTRACTOR, etc. Actual wording, layout, and final location will be determined by ENGINEER.
- E. Mount plaque by concealed fastening, using studs on back, set in cement.
- F. Plaque shall be equal to those manufactured by Metal Arts, Mandan, North Dakota; A.R.K. Ramos Signage Systems, Oklahoma City, Oklahoma, or equal.

2.03 ROOM SIGNS

- A. Provide room signs, W.H. Brady Co., B-909, or equal. OWNER shall select color.
- B. Sign shall also incorporate handicap-accessible symbol.

2.04 SITE SIGNS

- A. Provide site signs as shown on the drawings. Signs shall be reflective sheeting on 0.070-inch aluminum, W.H. Brady Co., B-959, or equal. Signs shall be mounted on steel U-channel posts, W.H. Brady Co., 97205, or equal.

2.05 FIRE WALL SIGNS

- A. Marking and identification of all fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions or any other wall required to have protected openings shall be effectively and permanently identified with signs or stenciling and shall meet the three following requirements:
 - 1. Shall be located in accessible concealed floor, floor-ceiling, or attic spaces.
 - 2. Shall be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partition. Shall be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition.
 - 3. Shall include lettering not less than 1/2 inch in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" or other wording. Shall include lettering not less than 3 inches in height with a minimum 3/8-inch stroke in a contrasting color incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" or other wording.
- B. Sign shall indicate fire rating of wall or partition. Refer to code review drawing, included in drawing set, for fire rated partition locations and rating. See schedule below.

2.06 DANGER SIGNS

- A. CONTRACTOR shall provide danger signs complying with OSHA requirements. Signs shall state Danger-Permit Required Confined Space Do Not Enter.
- B. Signs shall be fiberglass, Brady Systems, or equal, minimum size 7 inches by 10 inches. Colors shall be red and black on white.
- C. The number of signs required is 6.

2.07 NON-POTABLE WATER HYDRANT SIGNS

- A. Non-potable Water and Caution Signs: Place non-potable water signs permanently mounted at every hose bib, hydrant, or faucet on the non-potable water system. Sign shall include as a minimum the wording "NOTICE, NON-POTABLE WATER, DO NOT DRINK." Signs shall be Brady Safety sign, or equal, minimum size 6 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners. At yard hydrant, provide post-mounted signs on steel U-channel posts.
- B. The number of signs required is 4.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after surfaces are finished in locations as shown on the drawings.

3.02 SCHEDULES

- A. Provide one facility sign where shown on drawings.
- B. Provide one bronze plaque mounted where indicated by OWNER.
- C. Provide one unisex restroom sign at Control Building.
- D. Provide CAUTION signs at all wet wells, screening channel, UV and Post-aeration Tank, and the Sludge Storage Tank. Provide six total.

END OF SECTION

SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Toilet, bath, and washroom accessories.
 - 2. Grab bars.
 - 3. Attachment hardware.

1.02 REFERENCES

- A. ANSI A117.1–Safety Standards for the Handicapped.
- B. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A269–Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- D. ASTM A1008–Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- E. ASTM B456–Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.03 REGULATORY REQUIREMENTS

- A. Conform to ANSI A117.1 and Federal ADA-AG code and the 2017 Ohio Building Code for access for the handicapped.

PART 2–PRODUCTS

2.01 TOILET TISSUE DISPENSERS

- A. Dispensers shall be surface-mounted. Provide total of one. Model shall be as follows:
 - 1. No. 0697-GAL, by American Specialties, Inc.
 - 2. B-2840, by Bobrick Washroom Equipment, Inc.
 - 3. Model 5263, by Bradley Corporation.
 - 4. Or equal.
- B. Unit shall be smoke finish.

2.02 SOAP DISPENSER

- A. Surface-mounted liquid soap dispensers shall be GOJO FMX-12 dispenser, or equal. Provide total of one.

- B. Unit shall be chrome-plated brass with plastic container. Unit shall be impact-resistant polymer with corrosion-resistant valve capable of dispensing EA-rated soaps.
- C. Install one above each toilet room sink.

2.03 TOWEL DISPENSERS

- A. Surface, wall-mounted, GP Pacific Blue Ultra Mechanical High Capacity paper towel dispenser (59589) as manufactured by Georgia Pacific, LLC. Provide total of one.
- B. Unit shall be smoke finish.
- C. Locate near toilet room sinks.

2.04 WASTE RECEPTACLE

- A. Waste receptacles shall be swing-type, free-standing Bobrick B-2250, Bradley 377-36, or equal.
- B. Units shall be stainless steel with satin finish.
- C. Provide one unit.

2.05 MIRRORS

- A. Mirrors shall be shelfless mirrors without frames, 24 inches by 42 inches high, Bradley 747 with clip fasteners, or equal. Provide total of one.

2.06 GRAB BARS

- A. Provide stainless steel, peen grip with satin finish, 1 1/4-inch-diameter grab bars. Bars shall be concealed mounted-type, Bobrick B-550.99X18, B-550.99X36 and B-550.99X42; Bradley 832-00118, 832-00136 and 832-00142, or equal.
- B. Provide stainless steel, peen grip with satin finish 1 1/4-inch-diameter grab bar. Bar shall be concealed mounted-type, Bobrick B-58616, Bradley 832-059, or equal.
- C. See drawings for configuration of grab bars.
- D. In Restroom Stalls:
 - 1. Provide one 18-inch grab bars.
 - 2. Provide one 36-inch grab bars.
 - 3. Provide one 42-inch grab bars.

2.07 UNDERSINK PROTECTIVE PIPE COVERS

- A. ADA-conforming, wheelchair-accessible lavatory P-trap and angle valve assemblies shall be covered with molded, antimicrobial undersink protective pipe covers, TRUE BRO, INC. LAV GUARD No. 103 and No. 403, 1-800-340-5969, or equal.
- B. Cover shall be secured with reusable fasteners and access covers.

- C. Coordinate protective pipe covers for tailpiece and extensions to fit lavatories.
- D. Standard color to be selected by OWNER.

2.08 KEYING

- A. Supply two keys for each accessory to OWNER.
- B. Key all accessories alike.

PART 3-EXECUTION

3.01 INSTALLATIONS

- A. Install accessories in accordance with manufacturers' instructions, ANSI A117.1, Federal ADA-AG, and the 2017 Ohio Commercial Building Code.
- B. Install plumb and level securely and rigidly anchored to substrate.

END OF SECTION

SECTION 10 43 16

FIRST AID KIT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: First aid kit.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

2.01 MANUFACTURER

- A. First aid kit shall be SmartCompliance First Aid Cabinet Model No. 90580 wall-mounted (50-person 202-item kit). First aid only Model No. 225AN (50 person 196-item kit)., or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. First aid kit shall be wall-mounted.
- B. Mount in the Electrical Building where requested by OWNER.

END OF SECTION

SECTION 10 44 43

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Fire extinguishers.
 - 2. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 10–Portable Fire Extinguishers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

1.04 QUALITY ASSURANCE

- A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Larsen's Manufacturing Company, Product MP Series.
- B. Substitutions: Under provisions of Section 01 60 00–Materials and Equipment.

2.02 EXTINGUISHERS

- A. Provide two dry-chemical-type, Larsen's MP Series, 10-pound-capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B, and Class C fires.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers in brackets where shown on the drawings.
- C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.
- D. The fire extinguishers will be located in the following buildings: Electrical Building.

END OF SECTION

SECTION 11 53 00

LABORATORY FURNITURE AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Steel casework.
 - 2. Work surfaces.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. SEFA 8: Laboratory Furniture, Casework, Shelving, and Tables Guidelines Science Equipment and Furniture Association (SEFA).

1.03 CASEWORK DESIGN REQUIREMENTS

- A. Flush Construction: Surfaces of doors, drawers, and panel faces shall align with cabinet fronts without overlap of case ends and top or bottom rails. Horizontal- and vertical-case shell members (panels, top rails, and bottoms) shall meet in the same plane without overlap, cracks, or crevices.
- B. Self-Supporting Units: Completely welded shell assembly without applied panels at ends, backs, or bottoms so that cases can be used interchangeably or as a single, stand-alone unit.
- C. Interior of Case Units: Easily cleanable, flush interior. Cupboard bottom shall be full depth and width of unit on all cases to prevent dust from entering cabinet.
- D. Drawers: Sized on a modular basis for interchange to meet varying storage needs, and designed to be easily removable in field without the use of special tools.
- E. Case Openings: Rabbeted-like joints all four sides of case opening for hinged doors and two sides for sliding doors to provide dust-resistant case.

1.04 CASEWORK PERFORMANCE REQUIREMENTS

- A. Structural Performance Requirements: Casework components shall withstand the following minimum loads without damage to the component or to the casework operation:
 - 1. Steel base unit load capacity: 500 pounds per linear foot.
 - 2. Suspended units: 300 pounds.
 - 3. Drawers in a cabinet: 150 pounds.
 - 4. Utility tables (four-legged): 300 pounds.
 - 5. Hanging wall cases: 300 pounds.
 - 6. Load capacity for shelves of base units, wall cases, and tall cases: 100 pounds.

- B. Metal Finish Performance Requirements:
1. Hardness: Surface hardness equivalent to 4H pencil, minimum.
 2. Humidity resistance: Withstand 1,000-hour exposure in saturated humidity at 100°F, per ASTM D2247-85.
 3. Moisture resistance:
 - a. No visible effect to surface finish after boiling water trickled over test panel inclined at 45 degrees for 5 minutes.
 - b. No visible effect to surface finish following 100-hour continuous application of a water-soaked cellulose sponge, maintained in a wet condition throughout the test period.
 4. Adhesion: Score finish surface of test panel with razor blade into 100 squares, 1/16 inch by 1/16 inch, cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 90 squares shall maintain their finish.
 5. Salt spray: Withstand minimum 250-hour salt spray test, per ASTM B117-85.
- C. Chemical Resistance Finish Performance Requirements:
1. Test procedure: Apply 10 drops (approximately 0.5 cubic centimeters) of each reagent identified in the SEFA 8 requirements to the surface of the finished test panes laid flat and level on a horizontal surface. Ambient temperature: 68° to 72°F (20° to 22°C). After 1 hour, flush away chemicals with cold water and wash surface with detergent and warm water at 150°F (65.5°C) and with alcohol to remove surface stains. Examine surface under 100 foot-candles of illumination.
 2. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:
 - a. Level 0—No detectable change.
 - b. Level 1—Slight change in color or gloss.
 - c. Level 2—Slight surface etching or sever staining.
 - d. Level 3—Pitting, cratering, swelling, erosion of coating, obvious and significant deterioration.
 3. Test results to match SEFA 8 requirements for color selected by OWNER.

1.05 WORK SURFACE PERFORMANCE REQUIREMENTS

- A. Test Procedure: Apply five drops of each reagent to surface and cover with 25 mm watch glass, convex side down; test volatiles using 1-ounce bottle stuffed with saturated cotton. After 24-hour exposure, flush surface clean, rinse, and wipe dry.
- B. Evaluation Ratings: Change in surface finish and function shall be described by the following ratings:
1. No effect: No detectable change in surface material.
 2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
 3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
 4. Fair: Objectionable change in appearance because of surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
 5. Failure: Pitting, cratering, or erosion of work surface material; obvious and significant deterioration.
- C. Test Results—Epoxy Resin Work Surface: Test results to comply with Thermo Hamilton Epoxy Resin Work Surface Test.

1.06 SUBMITTALS

- A. Submittals shall comply with the requirements of Section 01 33 00–Submittals.
- B. Shop Drawings: Provide 1/2-inch = 1-foot 0-inch scale elevations of individual and battery of casework units, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relation of units to surrounding walls, windows, doors, and other building components. Provide 1/4-inch = 1-foot 0-inch rough-in plan drawings for coordination with trades. Rough-in shall show free area.
- C. Test Reports: Submit test reports verifying conformance to test performance specified.

1.07 QUALITY ASSURANCE

- A. Single Source Responsibility: Casework, work surfaces, and accessories shall be manufactured or furnished by a single laboratory furniture company.
- B. Manufacturer's Qualifications:
 - 1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
 - 2. Ten installations of equal or larger size and requirements.
- C. Installer shall be factory-certified by the manufacturer.
- D. Cabinet Identification: New cabinets to be installed are identified on drawings by letter. New equipment to be installed is identified by double letters. Unless otherwise modified on drawings or in specifications, catalog description constitutes specific requirements for each type of cabinet.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Schedule delivery of casework and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.
- B. Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.
- C. Protect all work surfaces throughout construction period with 1/4-inch corrugated cardboard completely covering the top and securely taped to edges. Mark cardboard in large lettering "No Standing."

1.09 PROJECT CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weathertight.
 - 2. Ceiling, overhead ductwork, and lighting are installed.
 - 3. All painting is completed and flooring is installed.

PART 2-PRODUCTS

2.01 LABORATORY FURNITURE

- A. Acceptable manufacturer includes the following, or equal: Mott Manufacturing, Ltd. (Brantford, Ontario, Canada).
- B. Schedule of items to be provided is as follows: Model Nos. refer to Mott, unless otherwise noted.

Designation	Description	Model No.
A	15-inch base cabinet	1920222
B	30-inch apron with drawers	AUA01330
C	15-inch base cabinet	1920022

- C. Provide scribing strips, filler panels, and enclosures as required.

2.02 CASEWORK MATERIALS

- A. Sheet Steel: Mild, cold-rolled, and leveled unfinished steel.
- B. Minimum Gauges:
 - 1. 20 Gauge: Solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, and security panels.
 - 2. 18 Gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels, and access panels.
 - 3. 16 Gauge: Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, and leg rails and stretchers.
 - 4. 14 Gauge: Drawer suspensions, door and case hinge reinforcements, and front corner reinforcements.
 - 5. 11 Gauge: Table leg corner brackets and gussets for leveling screws.
- C. Glass for Glazed Swinging and Sliding Doors: 7/32-inch (6 mm)-thick, clear laminated safety glass.

2.03 CASEWORK FABRICATION

- A. Base Units and Cases:
 - 1. Base units and 25-inch-, 31-inch-, and 37-inch-high wall cases: End panels and back reinforced with internal reinforcing front and rear posts.
 - 2. 49-inch- and 84-inch-high cases: Formed end panels with front and rear reinforcing post channels; back shall be formed steel panel, recessed 3/4 inches for mounting purposes.
 - 3. Posts: Front post fully closed with full height reinforcing upright. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to 1/2 inch on center.
 - 4. Secure intersection of case members with spot and arc welds. Provide gusset reinforcement at front corners.

- B. Drawers:
1. Drawer fronts: 3/4-inch-thick, double-wall construction, prepainted prior to assembly, and sound-deadened; top front corners welded and ground smooth.
 2. Drawer bodies: Bottom and sides formed into one-piece center section with bottom and sides coves and formed top edges. Front and back panels spot-welded to center section.
 3. Drawer suspension: Heavy-duty coved raceways for both case and drawer with nylon-tired, ball-bearing rollers; self-centering and self-closing when open to within 5 inches of the closed position.
 4. Provide drawer with rubber bumpers. Friction centering devices are not acceptable.
 5. Provide security panels for drawers with keyed different locks.
 6. File drawers: Provide with full extension slides for full access and operation.
- C. Doors:
1. Solid panel doors: 3/4 inches thick, double wall, telescoping box steel construction with interior prepainted and sound-deadened; all outer corners welded and ground smooth. Reinforce interior of front panel with welded steel hat channels. Hinges with screws to internal 14 gauge reinforcing in case and door. Hinges shall be removable; welding of hinges is not acceptable. Doors shall close against rubber bumpers.
 2. Frame-glazed doors: Outer head to be one-piece construction. Inner head to consist of top, bottom, and side framing members that are removable for installation or replacement of glass. Provide continuous vinyl glazing retainer to receive glass. In all other respects, framed glazed door construction and quality shall match solid panel doors.
 3. Sliding doors, solid- or framed-glazed: Design for tilt-out removal after removal of bottom guide. Doors shall be hung with nylon-tired sleeve-bearing rollers in formed steel, top-hung track and shall close against rubber bumpers.
 4. Unframed sliding glass doors: Glass with edges ground set in extruded aluminum shoe with integral pulls, wheel assemblies, and top and bottom extruded aluminum track. Provide rubber bumpers at fully opened and closed door position.
- D. Shelves:
1. Form front and back edges down and back 3/4 inches. Form ends down 3/4 inches.
 2. Reinforce shelves over 36 inches long with welded hat channel reinforcement the full width of shelf.
 3. Pull out shelves: Same suspension as specified for drawers.
- E. Base Molding: 4 inches high, black rubber or vinyl; inside corners mitered and outside corners wrapped. Base molding around lab casework is by flooring contractor.
- F. Hardware:
1. Drawer and hinged door pulls: Clear anodized extruded aluminum, screw attached on minimum 4 1/4-inch centers.
 2. Sliding door pulls: Recessed stainless steel, styled and sized to harmonize with drawer pulls.
 3. Hinges: Institutional-type, five knuckle-projecting barrel hinges, minimum 2 1/2 inches long, Type 302 or 304 stainless steel. Provide two hinges for doors up to 36 inches high; three hinges for doors over 36 inches high. Drill each leaf for three-screw attachment to door and frame.
 4. Door catches: Adjustable-type, spring-actuated nylon roller catches.
 5. Elbow catches: Spring-type of cadmium-plated steel, with strike of suitable design.

6. Locks: National Lock Remove-A-Core 5-disk tumbler, heavy-duty cylinder type. Exposed lock noses shall be dull nickel (satin) plated and stamped with identifying numbers.
7. Label holders: Formed steel with satin chrome finish, 1 inch by 1 1/2 inches, screw installed. Label holders will be provided where shown on elevation drawings.
8. Shelf clips: Die-formed steel, zinc-plated, designed to engage in shelf adjustment holes.
9. File followers: Metal backs engaging in steel bottom channel with spring positioning lock.

2.04 METAL FINISH

- A. Prepare all surfaces, make free of defects with welds ground smooth and indistinguishable from surrounding metal.
- B. Components shall be cleaned in a four-stage chemical spray process that produces an iron phosphate coating bonded to the steel surfaces. Components shall be thoroughly oven-dried before painting.
- C. Components shall be electrostatically coated with an epoxy/urethane powder applied in a controlled environment then baked/cured in a temperature controlled oven to provide a smooth hard finish. Surface shall be a chemical resistant, high quality laboratory grade finish. The resulting paint coating shall provide a minimum film thickness of 1.2 mils on all exposed parts and an average film thickness of 1.0 mils on all other surfaces.

2.05 EPOXY RESIN WORK SURFACE

- A. Material: Chemical- and abrasion-resistant, durable countertop of 1-inch-thick cast material of epoxy resins and inert products, cast flat, with a uniform low-sheen black surface. Provide new countertop, curbs, ledges, and reagent rack tops throughout new laboratory.
- B. Backsplash Curb: Same material as countertop, 6 inches high, butt-jointed, and cemented to top. Provide where indicated on drawings and at reagent ledges. Include end curb where top abuts end wall.
- C. Ledges: Same material as countertop. Provide 6-inch-high by 7 1/2-inch-wide single-faced units and 6-inch-high by 9-inch-wide double-faced units. Ledge face shall permit installation of service fixtures and top shall be removable for access to service utilities. Ledges are required only if shown on drawings.
- D. Reagent Rack Top: Same material as countertop.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Casework Installation:
 1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
 2. Bolt continuous cabinets together with joints flush, tight, and uniform and with alignment of adjacent units within 1/16-inch tolerance.
 3. Secure wall cabinets to solid supporting material, not to plaster, lath, or gypsum board.

4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.
- B. Work Surface Installation:
1. Where required because of field conditions, scribe to abutting surfaces.
 2. Only factory-prepared field joints located in accordance with approved shop drawings shall be permitted. Secure joints in field where practicable in the same manner as in factory with dowels, splines, adhesive, or fasteners recommended by manufacturer.
 3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
- C. Accessory Installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.02 ADJUSTING

- A. Repair or remove and replace defective work as requested by ENGINEER upon completion of installation.
- B. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

3.03 CLEANING

- A. Clean shop-finished casework, touchup as required.
- B. Clean counter tops with diluted dishwashing liquid and water, leaving tops free of all grease and streaks. Do not use wax or oils.

3.04 PROTECTION OF FINISHED WORK

- A. Provide all necessary protective measures to prevent exposure of casework and equipment to other construction activity.
- B. Advise CONTRACTOR of procedures and precautions for protection of material and installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION

SECTION 13 34 18

POLE BUILDINGS

PART 1–GENERAL

1.01 SUMMARY

- A. Work included:
 - 1. Providing and installing a pre-engineered pole building. CONTRACTOR shall design all portions of the building.
 - 2. Framing and other building components are specified in other sections of the specifications. CONTRACTOR shall provide all necessary components for a complete, weathertight installation.
- B. The intent of these specifications and drawings is to establish a quality and performance level for structural design, material, durability, and workmanship.
- C. The building shall be the design of a manufacturer who is regularly engaged in the fabrication of pre-engineered structures. All materials shall be new, unused, and free from defects.

1.02 REFERENCES

- A. *Cold Formed Steel Design Manual*–American Iron and Steel Institute.
- B. ASTM A792/A792M–Steel Sheet, Aluminum–Zinc Alloy Coated by the Hot-Dip Process.
- C. NFPA–National Design Specifications for Wood Construction.
- D. The following criteria shall also be applicable in other phases of design:
 - 1. 2015 International Building Code.
 - 2. ASTM Standards.

1.03 BUILDING DESCRIPTION

- A. The Storage building has a 12-foot, 0-inch truss bearing height.
- B. The main roof slope shall be 4 inches in 12.
- C. The drawings show a surface mounted pole on concrete foundation wall. Lateral loads perpendicular and parallel to the ridge shall be carried through frame action with knee bracing, as necessary.
- D. CONTRACTOR shall design and provide any necessary expansion joints.

1.04 DESIGN LOADS

- A. The basic design loads shall include live and wind, in addition to dead load. All other design loads, whether they be of static, dynamic or kinetic nature, shall be considered as auxiliary loads.

- B. Vertical Live Loads:
 - 1. Purlins shall be designed for snow loads and minimum live loads in accordance with the 2015 International Building Code uniformly distributed over the roof area which they support.
 - 2. Primary frames shall be designed for snow loads and minimum live loads in accordance with the 2015 International Building Code uniformly distributed over the roof area which they support and for concentrated loads shown on the drawings.
 - 3. All of the above loads to be in addition to the applicable dead loads and shall be applied to the horizontal projection of the roof.
- C. Wind and Seismic Loads: All wind and seismic loads on the structure shall be determined and applied as horizontal and uplift forces in accordance with the 2015 International Building Code.
- D. Auxiliary Loads: Other superimposed static loads due to equipment shall be considered as part of the design requirements and combined with the normal design loads.
- E. Combination of Loads: The combining of loads for design purposes shall be in accordance with the Wisconsin Commercial Building Code.
- F. Minimum pole connecting to concrete foundation wall are to be calculated by the building designer.
- G. Certification: After the awarding of the Contract, complete structural analysis shall be submitted by the building manufacturer to ENGINEER.
- H. Structural Design:
 - 1. Perform calculations using diaphragm design analysis. Incorporate bracing as required if building exceeds diaphragm requirements.
 - 2. Comply with AF&PA *National Design Specification for Wood Construction (NDS)*.
 - 3. Trusses:
 - a. Limit deflection for live or snow loads to L/240.
 - b. Comply with appropriate NDS and Truss Plate Institute (TPI) standards.
 - 4. Metal Roof and Wall Panels:
 - a. Design in accordance with *AISI Specifications for the Design of Light gauge, Cold-Formed Steel Structural Members* and in accordance with sound engineering methods and practices.
 - b. Design to support a 200-pound (90 kg) load evenly distributed over a 2-foot (60 mm) square area centered between purlins; limit deflection to L/180 in a two-span condition.
 - 5. Expansion/Contraction Provisions: Design clip attachment system to allow for expansion and contraction of metal roofing because of seasonal temperature variations without detrimental effect to the roof panels.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Division 01.
- B. Product Data: Provide data on profiles, component dimensions, wood-grade and treatment, fasteners, and wall and roof panels.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, openings, and loads; wall and roof system dimensions, panel

layout, general construction details, anchorages and method of anchorage, provide licensed/registered professional seal and signature.

D. Provide structural calculations stamped by an engineer licensed in the State of Wisconsin.

1.06 WARRANTIES

A. Treated wood columns shall be warrantied against decay for 50 years.

B. Siding shall be warranted against fading of more than 6 MBS units over a 10-year period, chalking in excess of a numerical rating of 6 over a 10-year period, and checking, cracking, and peeling for a period of 20 years.

C. Roofing shall be warranted watertight for a period of 10 years.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

A. The products of the following manufacturers, or equal, are acceptable, provided that they comply with the remainder of this specification:

1. Lester Buildings.
2. Cleary Building Corporation.

B. These products are set up as a standard of quality. Other manufacturer's products will be accepted if they are equal in quality.

2.02 MATERIALS

A. Columns: The structural columns shall be a nailed laminated-column consisting of No. 1 Southern Pine Lamina. Each lamination shall extend from footing to eave without splice. Lamination shall be of adequate size and number to resist design loads.

B. Framing Lumber: See Section 06 11 00-Wood Framing and Sheathing.

C. Roof Trusses: See Section 06 17 53-Plate Connected Wood Trusses.

D. Wall and Roof Covering and Supports:

1. Wall and Roof Panels:

- a. Exterior wall panels shall be minimum 28 gage, A250 Galvalume, 80 KS; steel with 7/8-inch major rib depth.
- b. The covering width and configuration of the panel shall be the building manufacturer's standard, provided all design criteria, including deflection, is met or exceeded.
- c. Panels shall be prepainted with silicone polyester, Colorweld SP, or equal, paint system. Color shall be selected by OWNER from manufacturer's standard colors. Interior finish shall be a clear-wash coat.
- d. Fasteners shall have neoprene gasket washers and heads finished to match panels.

2. Girts and Purlins:

- a. The girts' and purlins' configuration and thickness shall be the building manufacturer's standard, provided all design criteria, including deflection and girt spacing, is met.

- b. Based on a simple span, the deflection of the girts (supporting the wall covering) shall not exceed $L/180$ and purlin deflection shall not exceed $L/240$ when supporting the applicable design load previously described.
 - c. Provide blocking and support at all openings, and surface mounted HVAC and electrical equipment. Coordinate with HVAC and electrical manufacturers.
- E. Ceiling and Wall Liner Panel:
- 1. Provide liner panel on ceiling and walls as noted on drawings.
 - 2. Liner panel shall be minimum 30 gage G40 galvanized steel panels with finish that is suitable for interior use. Color shall be white.
 - 3. Provide minimum of 2 by 4 joists at 48 inches on center to support ceiling.
 - 4. Screw panels to joists with steel or aluminum fasteners.
- F. Accessories:
- 1. Soffit and Fascia: Provide manufacturer's standard vented aluminum soffits and fascia. Finished to match exterior panels.
 - 2. Other Accessories: Doors, HVAC, and electrical equipment, etc., are specified elsewhere in these specifications.
 - 3. Gutters and Downspouts: See Section 07 71 23–Gutters and Downspouts. Provide precast concrete splash pads where shown on the Drawings.
 - 4. Snow Guards: Provide manufactures standard snow guards above door openings where shown on the Drawings. Snow guards shall extend 1 foot beyond each door edge.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are acceptable for erection/installation of preengineered wood building system.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory conditions.
- C. Commencement of work by erector/installer is acceptance of site conditions.

3.02 ERECTION-STRUCTURAL FRAMING

- A. Erect in accordance with manufacturer's instructions and approved shop drawings.
- B. Provide temporary erection and wind load bracing to maintain structure plumb and in alignment until installation of permanent bracing and/or roofing and wall coverings are completed.
- C. Do not field-cut or alter structural members without approval of manufacturer.

3.03 INSTALLATION

- A. Metal Roofing:
 - 1. General: Install in accordance with manufacturer's instructions. Secure to structural framing aligned, level and plumb. Space fasteners as shown on erection drawings.
 - 2. Sidelap: Minimum one full corrugation.
 - 3. Endlap: 8 inches for slopes 4 in 12. Secure together over and to structural members.
 - 4. Accessories: Install as shown on erection drawings.

- B. Metal Siding:
 - 1. General: Install in accordance with manufacturer's instructions. Secure to structural framing aligned, level, and plumb. Space fasteners as shown on erection drawings.
 - 2. Sidelap: Minimum one full corrugation.
 - 3. Field-cut end-wall panels to match roof slope.
 - 4. Fasteners: Wall panel-to-structural connections shall be made with galvanized fasteners with head to match panels.
 - 5. Accessories: Install as shown on erection drawings.
- C. Insulation: Follow manufacturer's instructions for the type(s) of insulation specified.
 - 1. Insulation with tabs: Overlap tabs and secure to provide continuous vapor barrier.
 - 2. Fill miscellaneous voids and cavity spaces to provide continuously-insulated envelope.
- D. Personnel Doors: Follow manufacturer's instructions.
- E. Joint Sealant Materials:
 - 1. Preparation: Clean joints and surfaces to receive sealants of foreign materials.
 - 2. Apply sealant with caulking gun using sufficient pressure to completely fill joints so that there is full contact of sealant to joint sides.
 - 3. Tool surface smooth and uniform, free of ridges, sags, and air pockets.
 - 4. Clean sealant from adjacent surfaces.
- F. Openings:
 - 1. All openings in metal wall panel for all trades shall be done by the erector. All openings with any dimension 6 inches or larger shall be framed to provide adequate support.
 - 2. All openings shall provide complete structure support and be sealed for weather-tightness.

3.04 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Touchup abrasions and other defects on prepainted metal panel surfaces with same type of primer and paint as original finish.
- C. Remove surplus material and debris from site.

END OF SECTION

SECTION 20 05 53

IDENTIFICATION FOR PLUMBING, AND HVAC PIPING AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, valve, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the drawings. CONTRACTOR shall identify including, but not limited to, all equipment, valves, piping, ductwork, dampers, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.03 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASME A13.1–Scheme for the Identification of Piping Systems.
 - 2. 2017 Ohio Building Code.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer’s unopened packaging with labels clearly identifying product name and manufacturer until ready for installation.
- B. Storage: Store materials in clean, dry area indoors until ready for installation.
- C. Handling: Protect materials and finish from damage during handling and installation.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Equipment tags, valve tags, and pipe markers shall be manufactured by Marking Services, Incorporated, Seton Name Plate Company, WH Brady Company, or Graphic Products, Inc.

2.02 EQUIPMENT TAGS

- A. Plastic Labels For Equipment (Indoor Application):

1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 22 and 23.
 2. Materials and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
 3. Character Color: Black.
 4. Background Color: White.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 1 inch by 3 inches.
 6. Minimum Letter Size: 1/4 inch.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment (Outdoor Application):
1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 22 and 23.
 2. Material: MS-215 Max-Tek with printed graphics protected by a chemical and UV resistant MS-3000 top laminate.
 3. Letter Color: Black.
 4. Background Color: White.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 1 inch by 3 inches.
 6. Minimum Letter Size: 1/4 inch.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.03 LABELING TAGS

A. Labeling Tags:

Use: Field-mounted devices (Limit switches, etc.).
Size: 1-inch by 3-inch.
Material: 1/32-inch-thick stainless steel.
Character Size: 1/4 inch.
Engraving: As requested by ENGINEER.

2.04 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.
- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.05 PIPE MARKERS

- A. Manufacturers: Marking Services, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.

- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels that stick directly to the pipe or insulation jacketing are not acceptable. Provide lettering in accordance with the following table.

PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4

PART 3-EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.
- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.
- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or

branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer’s instructions.
- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on drawings.
- D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.
- E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- F. Indicate delivered water temperature on domestic hot water supply and return lines.
- G. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Water Lines	
Non-potable water	Green/White
Potable water	Green/White
Other Lines	
Condensate	Blue/White
Exhaust	Blue/White
Refrigerant	Orange/Black
Plumbing drains and vents	Green/White

END OF SECTION

SECTION 22 05 19

GENERAL PLUMBING PIPING SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Piping specialties for all plumbing piping systems unless noted otherwise.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. All proper electrical connections, discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

PART 2-PRODUCTS

2.01 WATER HAMMER ARRESTORS

- A. Manufacturer: Sioux Chief, Wade, or Watts.
- B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with O-ring seals, FDA-approved silicone lubricant, suitable for operation in temperature range 35 to 150°F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts Series LF15M2 or LF15M2S, or equal.
- C. ANSI A112.26.1M, ASSE 1010; sized in accordance with PDI WH-201, with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Size unit to accommodate water supply fixture units being served by water hammer arrestor. Maximum working pressure 125 psig and maximum operating temperature of 300°F. Both casing and bellows shall be constructed of Type 304 stainless steel. Zurn Shoktrol water hammer arrestor model Z1700, Watts SS Series, or equal.

2.02 BACKFLOW PREVENTERS

A. Backflow Preventers:

1. Reduced Pressure Zone (RPZ) Type:
 - a. Manufacturers: Watts, or equal.
 - b. The assembly shall meet the requirements of ASSE 1013, AWWA C511.
 - c. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.
 - d. Test cocks.
 - e. Seats: Bronze, removable and replaceable, without removing valve from the line.
 - f. Checks: Independently operating.
 - g. Relief Valve: Independently operating, located between the two check valves.
 - h. Rated 175 psi maximum working pressure with continuous temperature range of 33°F to 140°F.
 - i. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.
 - j. Sizes 1/2 inch through 2 inches: Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections. Watts Regulator Company Series LFU009.
 - k. Sizes 2 1/2 inches through 10 inches: FDA epoxy-coated cast iron body, FDA epoxy-coated strainer, upstream and downstream OSY-UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Series LF-909.
2. Continuous Pressure Vacuum Breaker:
 - a. Tested and certified under ASSE 1056.
 - b. Suitable for continuous pressure hot and cold water.
 - c. Brass body and seat with silicone rubber discs.
 - d. Rated maximum pressure 150 psi and working temperature 33°F to 180°F.
 - e. Complete with quarter-turn ball valves and test cocks.
 - f. Sizes 3/8 inch through 1 inch: Spill-resistant, Watts Regulator Company Series 008PCQT, or equal.

2.03 NON-POTABLE WATER SIGNS

- ### A. Non-potable Water Caution Signs:
- Place non-potable water signs permanently mounted at every hose bib or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" or similar standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners.

2.04 LAVATORY THERMOSTATIC MIXING VALVE

- ### A. Provide Watts Model LFUSG, or equal.
- Valve shall be capable of operating pressure of 30 psi to 150 psi, operating flow 0.25 gpm to 2.25 gpm, hot water temperatures 120°F to 180°F, cold water inlet temperatures of 39°F to 80°F, hot inlet to outlet temperature differential of 5°F or less, and a field-adjustable outlet temperature of 80°F to 120°F. Valve shall comply with requirements of ASSE 1070. Valve shall be designed for under sink installation.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install water hammer arrestors where indicated and at quick closing valve installations.
- B. Install backflow preventers in accordance with the Ohio Building Code requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Valves of all descriptions except where indicated elsewhere.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00–Quality Control.

1.04 SYSTEM DESCRIPTIONS

- A. Performance Requirements:
 - 1. Lead-Free Requirements: All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe Drinking Water Act as amended January 4th, 2011 Section 1417. All products used in potable water systems shall be UL classified in accordance with ANSI/NSF 61 for potable water service and shall meet the low lead requirements of NSF-372.
 - 2. ANSI Z21.22–Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
 - 3. ASSE 1003–Water Pressure Reducing Valves for Domestic Water Supply Systems.
 - 4. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from OWNER.
 - 5. Valves shall be line size unless specifically noted otherwise.

1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves shall be used on the project. Temperature ratings specified are for continuous operation.

1.06 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 WATER SYSTEM VALVES (DCW, DHW, NPW)

- A. All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.
- B. Provide valve extensions for valves installed in all piping with insulation.
- C. Shutoff valves in copper piping 3 inches in diameter and smaller shall be two-piece bronze body, solder joint or threaded ends, chrome plated bronze ball, glass filled Teflon seat, Teflon packing and threaded packing nut, blowout-proof stem, 600 psi. Apollo 70LF-200, Milwaukee UPBA150, Nibco S580-80-LF.

PART 3–EXECUTION

3.01 GENERAL

- A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- B. Mount valves in locations which allow access for operation, servicing and replacement.
- C. Provide valve handle extensions for all valves installed in insulated piping.
- D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.
- E. Prior to flushing of piping systems, place all valves in the full-open position.

3.02 SHUT-OFF VALVES

- A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and elsewhere as indicated.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Hangers and supports for Plumbing Piping and Equipment.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00–Quality Control.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.05 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Anvil, B-Line, Pate, G-Strut, Piping Technology, Roof Products & Systems or approved equal.

2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2-Inch through 2 Inches:
 - 1. Carbon steel, adjustable swivel ring. B-Line B3170, Anvil 69 or 70.
 - 2. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- B. Hangers for Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- C. Wall Support:
 - 1. Carbon steel welded bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
 - 2. Perforated, epoxy painted finish, 16-12 gauge, minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS 200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series.
- D. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- E. Copper Pipe Supports: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

2.04 PIPE HANGERS AND SUPPORTS PROCESS AREA

- A. All hangers, rods, attachments, and supports to be stainless steel.
- B. Hangers:
 - 1. Adjustable stainless steel clevis hanger, B-Line B3100.
 - 2. Stainless steel trapeze hanger with u-bolts. See drawings for requirements.

2.05 PIPE HANGER RODS

- A. Steel Hanger Rods:
 - 1. Hanger rod shall be continuously threaded, complete with adjusting and lock nuts.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, shall not exceed the limits indicated.

Maximum Load (Lbs.)	Rod Diameter (inches)
(650°F Maximum Temperature)	
610	3/8
1,130	1/2
1,810	5/8
2,710	3/4
3,770	7/8
4,960	1
8,000	1 1/4

2.06 CONCRETE INSERTS

- A. Poured in Place:
 - 1. MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8-inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
 - 2. MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.
- B. Drilled Fasteners: Carbon steel drop-in type expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.07 CONTINUOUS CONCRETE INSERT CHANNELS

- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1 5/8-inch wide by 1 3/8-inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2,000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

2.08 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
- B. Install supports to allow free expansion of the piping system. Support all piping from the structure using concrete inserts, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- E. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.

- F. Perform welding in accordance with standards of the American Welding Society.

3.02 HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1 1/2-inch minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Horizontal Spacing	Maximum Vertical Spacing
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1 1/4"	6'-0"	10'-0"
Copper	1 1/2" through 2 1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	10'-0"	10'-0"
Ductile Iron ⁽¹⁾	All	5'-0"	15'-0"
PVC	All	4'-0"	10'-0"

⁽¹⁾ The maximum horizontal spacing for supports may be increased to 10 feet when 10-foot lengths of pipe are employed

- H. Any piping materials not explicitly listed above shall have pipe support provided at maximum spacing intervals as noted in the applicable code or manufacturer recommendations, whichever is more restrictive.

3.03 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

- A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6 feet 0 inch maximum centers and 2 feet 0 inch from corners. Furnish inserts to Division 03 for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

3.04 ANCHORS

- A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 22 07 19

PIPING INSULATION FOR PLUMBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 22–Plumbing.
 - 1. Rigid formed fiberglass insulation.
 - 2. Adhesives, mastic, sealants, and reinforcing materials.
 - 3. Jacketing.
 - 4. Insulation inserts and pipe shields.
 - 5. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASTM C168–Standard Terminology Relating to Thermal Insulation.
 - 2. ASTM C272–Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 - 3. ASTM C518–Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM C533–Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547–Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C612–Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 7. ASTM C1427–Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 8. ASTM D1000–Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 9. ASTM E84–Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 10. ASTM E96–Standard Test Methods for Water Vapor Transmission of Materials.
 - 11. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 12. NFPA 262–Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.

- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00—Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All PVC jacketing provided shall come factory finished. CONTRACTOR shall not paint PVC jacketing. Where painted insulation transitions to PVC jacketing, CONTRACTOR shall coordinate colors with OWNER. Colors shall be in accordance with Section 20 05 53-Identification for Plumbing and HVAC Piping and Equipment and Section 09 91 00—Painting.
- C. All insulation and associated materials shall be free of asbestos.

PART 2-PRODUCTS

2.01 RIGID FORMED FIBERGLASS INSULATION

- A. Acceptable manufacturers are Johns Manville Micro-Lok, or equal.
- B. Insulation shall be mineral fiber type conforming to ASTM C547, Type IV.
- C. Minimum nominal density shall be of 3.0 lbs/ft³.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service to 850°F.

2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive: Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.

2.03 JACKETING

- A. PVC Jackets (PVJ):
 - 1. PVC film, gloss finish one side, semi-gloss other side.
 - 2. PVC film shall conform to FED L-P-535D, Composition A, Type II, Grade GU.
 - 3. Jacket thickness shall be minimum 0.03 inches.
- B. ADA Accessible Lavatory Insulation: Provide Truebro, Inc. Lav-Guard, or equal, undersink piping cover. Piping cover shall meet applicable ADA requirements. The P-trap, angle valve assemblies, supply piping, and tailpiece shall be covered with the molded vinyl, antimicrobial pipe cover. Cover shall be secured with flush reusable fasteners; angle stop shall have locking access cover.

2.04 INSULATION INSERTS AND PIPE SHIELDS

- A. Acceptable manufacturers are B-Line, Pipe Shields, or Value Engineered Products.
- B. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- C. Wood blocks will not be accepted.
- D. All pipe shields shall be banded to the jacketing using stainless steel bands. One band is required on each side of the support.

2.05 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Load distributing metal shields shall be constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.
- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- B. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required.
- E. All un-insulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.

- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

3.03 RIGID FORMED FIBERGLASS INSULATION INSTALLATION

- A. Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9-inch to 12-inch on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of flexible closed cell joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc., for a minimum distance of 6 inches from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

3.04 PROTECTIVE JACKET INSTALLATION

- A. PVC Fitting Covers and Jackets (PVJ): Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4 inches without fasteners where required to absorb expansion and contraction. For sections where vapor retarding jacket is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor retarding jacket, apply a 1 1/2-inch band of mastic over ends, throat, seams and penetrations.
- B. Vapor Barriers:
 1. On systems operating at 50°F and above, pipe insulation jackets may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge. Mastics used shall be "breather" type allowing passage of water vapor.
 2. On systems operating below 50°F and on roof drain lines, insulation laps shall be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive. Jackets shall be applied with a continuous unbroken vapor seal. Mastics and adhesives used shall be vapor retarding type limiting passage of water vapor.

3.05 PIPING INSULATION

- A. Provide insulation on new piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1 1/2" to < 4"	4" to < 8"	8" and Larger
Cooling Coil Condensate Drain	Rigid Formed Fiberglass	PVJ	0.5"	0.5"	1"	1"	1"

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1 1/2" to < 4"	4" to < 8"	8" and Larger
Cold Water (Potable/Nonpotable)	Rigid Formed Fiberglass	PVJ	1"	1"	1"	1"	1"
Hot Water (Potable/Nonpotable)	Rigid Formed Fiberglass	PVJ	1"	1"	1"	1"	1"

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION PIPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All pipe, fittings, and appurtenances for domestic (hot and cold) potable and non-potable water within and to 5 feet beyond building perimeter.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM, AWWA, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA, or CISPI specification contained in this section.

1.05 DELIVERY AND STORAGE

- A. CONTRACTOR shall promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. CONTRACTOR shall cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Materials shall not be stored directly on grade. Pipe, tube, and fitting ends shall be protected so they are not damaged. Where end caps are provided or specified, CONTRACTOR shall take precautions so the caps remain in

place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Deliver, store, and protect in accordance with Section 01 60 00–Materials and Equipment.

PART 2–PRODUCTS

2.01 DOMESTIC WATER (NPC, NPH, POT)

- A. Copper Piping and Fittings: Piping smaller than 3 inches in diameter shall be Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half the diameter of the main.
- B. Ductile Iron Piping and Ductile Iron Fittings:
 - 1. Water piping 3 inches in diameter or larger shall be ductile iron conforming to ANSI/AWWA C151/A21.51, with flanged or grooved joints. Unless otherwise shown or specified, all piping shall be minimum special thickness Class 53 with a minimum rated working pressure of 250 psi for flanged pipe. Pipe wall thickness shall be furnished as required by AWWA C115 for flanged piping; AWWA C606 for grooved piping; special thickness Class 53 minimum unless otherwise shown or specified. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.
 - 2. The words “Ductile Iron” and the weight and class of pipe shall be plainly marked on each piece of pipe.
 - 3. All flanged sections of pipe shall be made up in strict accordance with AWWA C115 specifications. No field make-up flanges will be allowed unless strictly conforming to AWWA C115 with facing done after turning pipe through flange.
 - 4. Flanged joints shall conform to AWWA C110, C111, and C115, and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron. Flanged gaskets shall be minimum 1/8-inch, full-face, rubber-ring, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown.
 - 5. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
 - 6. Grooved Piping System:
 - a. A grooved piping system may be used in place of flanges. Housing shall be manufactured from ductile iron conforming to ASTM A536. The bolts and nuts shall be of track design and, unless otherwise required, shall be made of electroplated steel to conform to or exceed the requirements of ASTM A449 and A183. Gaskets shall be FlushSeal and conform to the requirements of ASTM D2000. Grooves cast or subsequently cut into ductile pipe, fittings, or other components shall conform to AWWA C606. All pipe used in a grooved piping system shall be gauged and shall pass a roundness test. A rigid joint system shall be used unless otherwise approved by ENGINEER.

- b. Fittings shall be ductile, ASTM A536, conforming to the requirements of AWWA C110/ANSI A21.10 for center to end dimensions, and AWWA C110/ANSI A21.10 or AWWA C153 for wall thickness, and AWWA C606 rigid radius grooving dimensions for end preparation.
7. All ductile iron piping and fittings conveying water above 100°F shall be cement mortar lined but not asphaltic-coated inside.

C. PVC Piping:

1. Except as otherwise specified, non-potable water piping in corrosive environments shall be constructed of PVC.
2. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
3. All piping shall be approved for use by the National Sanitation Foundation. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or where transition to another pipe material is required. Underground pressure piping shall be installed in compliance with ASTM D2774.

2.02 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2 inches and smaller; dielectric flanges 2 inches and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180°F.

2.03 UNIONS AND FLANGES

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180°F. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.
- B. 2 1/2-Inch and Smaller Copper: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

PART 3—EXECUTION

3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations, and recognized industry practices.

3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves, and piping specialties.
- E. Provide anchors, expansion joints, swing joints, and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

3.04 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking shall be allowed.

3.05 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Provide thrust restraints for 3-inch and larger exterior water piping joints, hydrants, caps, plugs, fittings, and bends of 22-1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.
- C. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

3.06 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.07 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located

at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.08 TESTING AND CLEANING

A. General:

1. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
2. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests, flushing, sterilization. CONTRACTOR shall also provide all temporary sectionalizing devices and vents as required.
3. All new plumbing system piping shall be tested for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
4. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, CONTRACTOR shall perform alternate testing procedures if acceptable to ENGINEER. Alternate testing procedures for minor installation and repairs may include visual evaluation of installed components by ENGINEER during a simulation of use.
5. The water used for tests shall be obtained from a potable source of supply.
6. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to ENGINEER before final payment is made.
7. Verify systems are complete, flushed, and clean prior to testing. Isolate or remove components subject to damage or not rated for test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Leave piping uninsulated, uncovered, and unconcealed until it has been tested. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. CONTRACTOR shall expose all untested covered or concealed piping.
8. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
9. Separately test above- and belowground piping.
10. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.
11. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with OWNER to determine areas and/or equipment considered as being sensitive.

12. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
13. CONTRACTOR shall be responsible for cleaning up any leakage during flushing, testing, repairing, and disinfecting to the original condition any building parts subjected to spills or leakage.
14. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground pressure mains prior to testing with the exception of thrust restrained valves that may be exposed to isolate potential leaks.
15. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
16. For air or nitrogen tests, gradually increase the pressure to not more than one-half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be accepted until it can be demonstrated that there is no measurable loss of test pressure during the test period.

B. Domestic Water System:

1. Subject piping system to a hydrostatic pressure of at least 100 pounds per-square-inch gauge, but not less than the operating pressure under which it is to be used. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully observed. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.
2. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24-hour disinfection period, test every outlet for a minimum chlorine residual of 50 parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million or the normal water supply's level.
3. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.
4. Prior to injection of chlorine into the piping system, strategically place signs stating "Heavily Chlorinated Water-Do Not Drink," and protect all outlets to prevent use during disinfection and flushing procedures.
5. A bacteria test may not be necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500-ppm chlorine solution. Materials should then be thoroughly rinsed before putting into service.

System	Test Medium	Initial Test Pressure	Duration	Pressure	Final Test Duration
Aboveground Domestic or Nonpotable Water	Water	N/A		100 psig	8 hours

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All plumbing pipe and pipe fittings for this project within and up to 5 feet from the building foundation wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00–Quality Control.
- B. Order all copper, cast iron, steel, PVC, and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification shall be replaced with material that meets these specifications without additional cost to OWNER.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on manufacturer's letterhead that pipe furnished meets the ASTM or CISPI specification contained in this section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, aboveground packaging.
- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.

- D. Storage and protection methods must allow observation to verify products.

1.05 DESIGN CRITERIA

- A. Use only new material, free of defects, rust, and scale, and meeting the latest revision of ASTM or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

PART 2–PRODUCTS

2.01 SANITARY WASTE AND VENT

- A. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue.
- B. Interior Above Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- C. Interior Below Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- D. Interior Above Ground, Pressurized: PVC plastic pipe, Schedule 40, Class 12454, ASTM D1784, ASTM D1785, with solvent cement joints, pressure rated, ASTM D2466, medium or long radius fittings; Primer, ASTM F656; Solvent, ASTM D2564.

PART 3–EXECUTION

3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in

the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves and piping specialties.
- E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.05 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer, and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3-inch and smaller piping only) or clean natural bristle brushes about half the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4 to 5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of

2 installers is required on piping 4 inches and larger. Hold joint for 30 seconds or until set. Reference manufacturer recommendations for initial set time before handling and for full curing time before pressure testing.

3.06 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.07 MECHANICAL JOINT PIPE CONNECTIONS

- A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

3.08 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Pipe shall be supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.09 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4-inch per foot where possible and in no case less than 1/8-inch per foot for piping 3 inches and larger.
- B. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

3.10 PIPING SYSTEM LEAK TESTS

- A. Drainage and Vent System:
 - 1. Subject gravity drainage and vent piping and joints to a test pressure and duration as outlined in the schedule at the end of this section. If, at end of indicated test duration, the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after another test duration period, there shall be no perceptible lowering of the water level in the system being tested.
 - 2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated because of test water leakage shall be tested with air. Air test may also be performed when allowed by ENGINEER. Isolate the test section from all

other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to ENGINEER.
4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.
5. Each floor drain P-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:
 - a. A request shall be submitted to OWNER, identifying the quantity and location of drain(s) to be observed.
 - b. Vacuum out each floor drain P-trap. An observation of the trap shall be performed to verify that the trap is debris free.
 - c. Perform a free-flowing test by pouring two 5-gallon buckets of water down the floor drain.
 - d. After confirming that the floor drain trap is clean and free of debris, review that the trap is filled with water.
 - e. At the discretion of ENGINEER, an observation of the trap using a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.
6. OWNER may require that any portion of the drainage, waste, and vent systems installed be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished using a sewer scope or other method as acceptable to ENGINEER.

- B. Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- C. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- D. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test shall be witnessed by OWNER or ENGINEER.

System	Test	Final Test	
	Medium	Pressure	Duration
Sanitary Waste and Vent	Water	10 feet water	2 hours

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes specifications for floor drains, roof drains, cleanouts, hub drains, and other miscellaneous plumbing specialties.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. New start-up shall confirm all proper electrical connections and discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2--PRODUCTS

2.01 FLOOR DRAINS

- A. All floor drains shall be furnished and installed with all options and accessories required for a leak-free installation within the particular construction in which they are to be mounted.
- B. (FD-1): Floor drains in finished areas or tiled areas, where shown on the drawings, shall be Zurn ZN-415, Type H, or Wade Model 1300-1-11, or Josam 32100-HP-7-2, with 6-inch round adjustable strainer top with integral clamping frame and secured heelproof grate. Provide polished nickel bronze top. Provide square grate for tiled floors.
- C. Each drain shall be provided with a trap. A minimum of one cleanout shall be provided for each single or common leader.
- D. Elevated floor drains above lower floor levels shall be installed with membrane flashing clamp to prevent water leakage to lower level. Install per manufacturer's recommendations.

2.02 TRAP GUARDS

- A. Manufacturer: ProSet Systems Trap Guard, Jay R. Smith Quad Close, Sure Seal or approved equal.
- B. Flexible elastomeric PVC construction diaphragm trap guard for installation in new floor drains, hub drains, and trench drains. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size, up to 4-inch size.

2.03 HUB DRAINS

- A. (HD-1): Provide Kusel Equipment, AWI Manufacturing, or Jay R. Smith 316 stainless steel hub drain. Drain shall consist of fully welded components. Portions of drain visible in final installation shall be blasted clean to remove discoloration and provide a uniform finished appearance. All pipe shall be sourced from the United States. Pipe thickness shall be Schedule 40.

2.04 CLEANOUTS

- A. Manufacturers shall be Zurn, Wade, Jay R. Smith, Josam, or Kusel.
- B. Each cleanout shall be gas- and watertight.
- C. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
- D. Interior concrete floor areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
- E. Interior exposed vertical stacks: Line-type cleanout tee with cast iron body and tapered threaded ABS closure plug; Zurn Z-1445.
- F. Interior horizontal lines: Cast iron hub with tapped ferrule and tapered, threaded ABS or PVC closure plug, or no-hub coupling and blind plug.

2.05 SAFINGS

- A. Manufacturers: Noble, Oatey, or equal.
- B. Chlorinated polyethylene sheeting, 40 mils thick, ASTM D4068, joined with CPE solvent; or 3 lb./sq. ft. sheet lead.

2.06 VENT FLASHINGS

- A. Manufacturers: Semco, Oatey.
- B. Formed 3 lb./sq. ft. lead flashing with minimum base size of 15 inches by 17 inches.
- C. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.
- B. Set floor drains, roof drains, trench drains and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow minimum of 18 inches clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape or waterproof grease. Install trap primer connections where indicated.
- C. Trap guards shall be provided in floor drains.
- D. Flash vent penetrations through roof. Turn down top of lead flashing into vent pipe. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to deck or membrane. Provide waterproof patch around penetration on existing roofs.

END OF SECTION

SECTION 22 13 29
SUBMERSIBLE PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: The following pumping systems and associated accessories: Sump pumps.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. Proper electrical connections, pump rotation, and discharge and suction gauge readings shall be provided in start-up report. A copy of the start-up report shall be made and sent to both the CONTRACTOR and to the ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 PLUMBING EQUIPMENT

- A. Sump Pumps:
 - 1. Manufacturers: Submersible sump pump(s) shall be manufactured by Hydromatic (H), Myers (M), PACO (P), Zoeller (Z), or equal. Furnish and install complete sump pump system(s) as shown on the drawings and specified herein. The complete system shall include pumps, electric controls, level controls, and all accessories.
 - 2. Schedule:

Pump No.	Model No.	Capacity (gpm)	TDH (ft)	Discharge Diameter	RPM	Voltage	Phase	HP	Location
SP-50-01	SPX50	30	20	2"	1,750	208	1	1/2	RAS/WAS Valve Vault

- 3. Type: Submersible pumps shall be constructed of epoxy-coated cast iron shell, cast iron volute, two-vane enclosed semiopen or recessed Vortex nonclog cast iron pump. Impeller shall be cast iron with a stainless steel shaft and stainless steel fasteners and

- have upper and lower ball bearings. Pump shall be oil-lubricated or factory-sealed grease-lubricated with a ceramic mechanical seal. Pump shall be capable of discharging 2-inch solids.
4. Motors: The motor shall be submersible-type, ball-bearing design, and oil-filled with built-in thermal overload protection sized for non-overloading over the entire pump curve. Motor housing shall be filled with dielectric pure, clean insulating oil. Motor shall have precision mechanical seal to prevent leakage into the housing. Seal faces shall be carbon and ceramic, super lapped for long leakproof life. Power cord and float switch cords shall be provided in lengths adequate to reach the control panel as provided by pump manufacturer. Pump motor shall be nonoverloading over the entire curve.
 5. Controls:
 - a. Electrical components specified within this section shall be provided in accordance with Division 26–Electrical Specifications. All electrical equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26.
 - b. Control Panel: A NEMA 4X control panel with controls as indicated below shall be furnished. The control panel shall include a combination starter, circuit breaker, H-O-A switch, green “Run,” and a red “Fail” push-to-test indicating light, elapsed time meters, red “HWL” push-to-test indicating light.
 - c. Auxiliary Contact(s): There shall be an auxiliary contact from the HWL alarm signal for remote indication at the SCADA.
 - d. Float(s): Level sensing shall be by mercury-free float switches, one each for pump ON, one for common pumps OFF, and one for HWL alarm at each station provided. All floats shall be intrinsically safe. Provide intrinsic safety barriers for each float switch. Intrinsic safety barriers shall be Phoenix Contact, Model MACX MCR-EX-SL-2NAM, (voltage as required), PR Electronics, Model 5202b2, or equal.
 - e. Pump controls as described above shall be provided using relay logic. Pump controls using printed circuit boards and/or programmable controllers will not be allowed.
 6. Accessories:
 - a. Rails: Dual stainless steel liftout guide rails with stainless steel wall, pump, and sump brackets. Provide bronze and neoprene quick-disconnect fitting and corrosion-proof pull chain or cable.
 - b. Piping: Provide dual check valves, full port ball valves, union or flange for each pump discharge, and flexible connectors.
 - c. Explosion proof Class I, Division 1, Groups C and D motor.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the 2017 Ohio Plumbing Code. Where requirements conflict, the stricter standard shall apply.
- B. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the CONTRACTOR, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the CONTRACTOR.

- C. CONTRACTOR shall identify piping, valves, and outlets in accordance with Division 09 and Section 20 05 53—Identification for Plumbing, and HVAC Piping and Equipment.
- D. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- E. Startup and test equipment adjusting operating and safety controls for proper operation.
- F. Lubricate pumps before start-up. Adjust pumps for rated flow. Clean and blow down strainers after 8 hours of operation. Remove suction diffuser strainers after initial system flushing and cleaning. Turn over to OWNER.
- G. Install pumps in accordance with manufacturer's instructions. Set level and plumb.
- H. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components.
- I. Provide isolation valves at plumbing equipment.

3.02 TESTING AND CLEANING

- A. General:
 - 1. The water used for tests shall be obtained from a potable source of supply.
 - 2. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to ENGINEER before final payment is made.
 - 3. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - 4. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
 - 5. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1–GENERAL

1.01 SCOPE

- A. This section includes specifications for water heaters and other equipment used for plumbing applications.
- B. Related Sections and Division: Applicable provisions of Division 01 shall govern work under this section.

1.02 QUALITY ASSURANCE

- A. Field inspection and testing to be performed under provisions of Section 01 45 00–Quality Control.
- B. Inspect completed installation for physical damage.

1.03 SHOP DRAWINGS

- A. Submit under provisions of Section 01 33 00–Submittals. Included in submittals shall be detailed control wiring diagrams that show logic circuits for the unit, as well as all external connections.

PART 2–PRODUCTS

2.01 WATER HEATERS

- A. Electric Instantaneous Water Heater (IWH-30-01):
 - 1. Manufacturers: Eemax (E), or equal.
 - 2. Type: Wall-mounted, tankless, UL listed, instantaneous electric water heater with digital microprocessing temperature control capable of maintaining outlet temperature of one degree accuracy, LED temperature display, 150 psig pressure rating, and capable of supplying multiple lavatories. Model SPEX4208T.
 - 3. Performance as scheduled on the drawings.
 - 4. Element shall be replaceable cartridge insert nickel chrome material.
 - 5. Accessories:
 - a. Provide Watts LFTWH, or equal, tankless water heater service valve. Pipe service, shutoff, drain, and relief valves in accordance with manufacturer's recommendations. Service valve installation shall include provisions for water heater purge and vinegar wash. Hot side: Watts LFTWH-UT/UTS-H-RV, or equal. Cold side: Watts LFTWH-UT/UTS-C, or equal.
 - b. Set pressure relief valves in accordance with local regulations.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- C. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor as indicated.
- D. Startup and test equipment adjusting operating and safety controls for proper operation.
- E. Provide isolation valves at plumbing equipment.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1–GENERAL

1.01 SCOPE

- A. This section includes specifications for plumbing fixtures, faucets and trim.

1.02 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

1.03 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.04 SHOP DRAWINGS

- A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.05 ENERGY EFFICIENCY REQUIREMENTS

- A. Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal Energy Management Program (FEMP) performance requirements.
 - 1. Lavatory Faucets: Flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 psi.)
 - 2. Water Closet Flush Valves: 1.6 gallons per flush or less.

PART 2–PRODUCTS

2.01 PLUMBING FIXTURES

- A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the following manufacturers determined to be equal by ENGINEER will be accepted.
 - 1. Water Closets: American Standard, Kohler, Zurn.
 - 2. Water Closet Seats: Bemis, Beneke, Centoco, Olsonite Sperzel.
 - 3. Service Sinks: American Standard, Crane, Kohler.

- B. Water Closets: WC-1: Floor mount bottom outlet white vitreous china siphon jet close coupled tank type water closet with elongated bowl, 2 1/4-inch passageway, 16 1/2-inch barrier free height, insulating tank liner and 1.6-gallon flush. ADA compliable.
 - 1. Fixture: Kohler Highline K-3427-U.
 - 2. Seat: Bemis 1655-SS/C white solid plastic open front seat.
- C. Service Sinks (SS-1): Aero Manufacturing Model MF1-2418-24R, or equal. Single compartment, 14 inch deep bowl, with 1 inch sanitary lip. Sink shall be constructed of 16 gauge, 304 stainless steel and be supported from the floor. Drainboard shall be on the right side of sink and pitched back to the compartment for positive drainage. Elkay LK940AT10T4S faucet with 8-inch faucet centers. Faucet shall include cross connection prevention device.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with IBC 1108 and 3408, COMM 52, 69 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27 inches above floor to avoid contact by wheelchair users.
- D. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- E. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, same items in concealed locations may be of rough brass finish.
- F. Set floor mounted water closets, floor mounted service sinks; drains with full setting bed of flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.
- G. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- H. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110-degree maximum outlet temperature.

- I. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1—GENERAL

1.01 SCOPE

- A. This section includes specifications for supports of all HVAC piping and equipment and materials as well as piping system anchors.

1.02 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

1.03 REFERENCE STANDARDS

- A. MSS SP-58 Materials, Design, Manufacture, Selection, Application, and Installation

1.04 QUALITY ASSURANCE

- A. Refer to Division 01, General Conditions, Equals and Substitutions.

1.05 DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- D. Protect insulation at all hanger points; see Related Work above.

1.06 SHOP DRAWINGS

- A. Refer to Division 01, General Conditions, Submittals.
- B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service.

1.07 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

- B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.
- C. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.
- D. Piping supported by laying on the bottom chord of joists or trusses will not be accepted.
- E. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- F. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

PART 2—PRODUCTS

2.01 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Anvil, B-Line, G-Strut, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers For Steel Pipe Sizes 1/2-Inch Through 2 Inches: Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.
- B. Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.
- C. Wall Support:
 1. Welded steel bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
 2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible

elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.

- D. Vertical Riser Support: Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.
- E. Floor Support For Pipe Sizes Through 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- F. Floor Support For Pipe Sizes 5 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.
- H. Insulation Protection Shields: Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2 1/2-inch and larger. Minimum shield length is 12 inches. Equal to Anvil figure 167.
- I. Steel Hanger Rods:
 - 1. Threaded both ends, threaded one end, or continuous threaded, black finish.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.)	Rod Diameter (inches)
(650°F Maximum Temperature)	
610	3/8
1,130	1/2
1,810	5/8
2,710	3/4
3,770	7/8
4,960	1
8,000	1 1/4

- 4. Provide rods complete with adjusting and lock nuts.

2.04 PIPE HANGERS AND SUPPORTS PROCESS AREA

- A. All hangers, rods, attachments, and supports to be stainless steel.
- B. Hangers:
 - 1. Adjustable stainless steel clevis hanger, B-Line B3100.
 - 2. Stainless steel trapeze hanger with u-bolts. See drawings for requirements.

2.05 CONCRETE INSERTS

- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.06 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.07 PIPE PENETRATIONS THROUGH ROOF

- A. Single Pipe Penetrations:
 1. A stack flashing penetration may be utilized for single pipe penetrations through built up roofs and single ply membrane roofs. Utilize high temperature sealant for all high temperature applications. This includes but is not limited to steam condensate vent piping, steam safety relief piping, and flues.
 2. A single pre-manufactured boot may be utilized for single pipe penetrations through single ply membrane roofs only.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Piping shall be supported independently from ductwork and all other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.
- D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.02 HANGER AND SUPPORT SPACING

- A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.

- E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Spacing
Steel	1/2" through 1 1/4"	6'-6"
Steel	1 1/2" through 6"	10'-0"
Thermoplastic	All sizes	6'-0"
Copper	1/2" through 1 1/4"	5'-0"
Copper	1 1/2" and larger	8'-0"

3.03 VERTICAL RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

3.04 ANCHORS

- A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Balancing air systems.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 11—Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
 - 2. SMACNA—HVAC Systems Testing, Adjusting, and Balancing.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Prior to final balancing, submit a preliminary report that includes the following design information for all control modes. Design information shall be from approved shop drawings. Report shall compare design and field tested data.
 - 1. For each supply, return and exhaust register, and ceiling outlet:
 - a. Room number.
 - b. Type of register and outlet and catalog size.
 - c. Air flow factor.
 - d. Design CFM and velocity.
 - e. Actual CFM and velocity.
 - f. Percent of design CFM.
 - g. Room pressure relationship.
 - 2. For each fan:
 - a. Unit number.
 - b. Fan size and wheel type.
 - c. Motor horsepower.
 - d. Motor nameplate voltage and amps.
 - e. Design CFM and static pressure (total pressure).
 - f. Actual CFM and static pressure (total pressure).
 - g. Actual fan RPM.
 - h. Actual motor voltage and amps (each phase).
- C. Provide summary sheet describing mechanical system deficiencies. Where not physically observable, provide pressure and/or flow readings to demonstrate suspected deficiencies.

Describe objectionable noise or drafts found during testing, adjusting, and balancing. All deficiencies shall be corrected prior to final balancing.

- D. Upon completion of final balancing, provide updated report indicating thermal performance testing and changes to system during final balancing for all control modes including updated airflows, pressures, velocities, etc. Final report shall be submitted prior to substantial completion.

1.04 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The organization shall have a certified membership in the Associated Air Balance Council (AABC) or certification by the National Environmental Balancing Bureau (NEBB).
- B. Division 23 shall provide a technician and/or controls contractor to observe and assist in balancing the system. Balancing report must include verification of participation, including name and contact information of assisting party.

PART 2–PRODUCTS

2.01 BALANCING EQUIPMENT

- A. CONTRACTOR shall have the following minimum equipment for balancing systems:
 - 1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
 - 2. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
 - 3. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
 - 4. Contact pyrometer 0 to 300°F range.
 - 5. Amprobe model RS-3, or equal.
 - 6. Inclined manometer 0 to 30 inches of water.
 - 7. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
 - 8. Instruments shall be applied in accordance with manufacturer's instructions.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

PART 3–EXECUTION

3.01 PRELIMINARY BALANCING

- A. Division 23 shall provide an experienced installer to review the air distribution system with the testing and balancing agency for completion to confirm the test openings and volume dampers indicated on the drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly during all control modes, air filters are clean, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices

as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

3.02 PRESSURE DIAGRAM

- A. Provide a diagram indicating, at minimum, the static pressure at the following points while system is operating at 100% airflow.
 - 1. Fan inlet.
 - 2. Fan outlet.
- B. Diagram shall include all components in an air handling unit and additional pressure points as required in thermal performance testing.
- C. Coordinate with Division 23 and equipment manufacturer to obtain readings where access is difficult or limited. Lack of readings due to inaccessibility will not be accepted.

3.03 SCHEDULE OF TOLERANCES

- A. Final air system measurements shall be within the following range of specified cfm:
 - 1. Fans: 0% to +10%.
 - 2. Supply grilles, registers, diffusers: 0% to +10%.
 - 3. Exhaust grilles, registers: 0% to -10%.
 - 4. Room pressurization air: -5% to +5%.

3.04 GENERAL REQUIREMENTS

- A. Perform testing, balancing, and adjusting procedures in accordance with AABC or NEBB, unless specified below.
- B. Contact the mechanical contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation for all control modes and any deficiencies found.
- C. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- D. Division 23 shall correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work, including sheave and pulley replacement or corrections to the controls system. Test and balance agency shall notify CONTRACTOR of these items and instructions will be issued to Division 23 for correction of the deficient work. Testing and balancing reports shall be submitted only after all deficiencies have been corrected and balancing completed upon the corrected system.

END OF SECTION

SECTION 23 07 19

PIPING INSULATION FOR HVAC

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 23–HVAC.
 - 1. Flexible closed cell pipe insulation.
 - 2. Adhesives, mastic, sealants, and reinforcing materials.
 - 3. Jacketing.
 - 4. Insulation inserts and pipe shields.
 - 5. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASTM C168–Standard Terminology Relating to Thermal Insulation.
 - 2. ASTM C272–Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 - 3. ASTM C518–Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM C533–Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547–Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C591–Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 7. ASTM C612–Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 8. ASTM C1427–Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM D1000–Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 10. ASTM E84–Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 11. ASTM E96–Standard Test Methods for Water Vapor Transmission of Materials.
 - 12. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 13. NFPA 262–Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. All pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.

PART 2–PRODUCTS

2.01 FLEXIBLE CLOSED CELL PIPE INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Armacell AP/Armaflex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C534, Type 1, Grade 1.
- C. K-factor shall not exceed 0.25 (btu-in)/(hr-ft²-°F) at 75°F mean.
- D. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

2.03 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Load distributing metal shields shall be constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.
- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3–EXECUTION

3.01 GENERAL

- A. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- B. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.

- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves.
- E. All uninsulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

3.03 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Where practical, slip insulation on piping during pipe installation while pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

3.04 PIPING INSULATION

- A. Provide insulation and jacketing on new piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1-1/2" to < 4"	4" to < 8"	8" and Larger
Heat Pump Piping Operating >50°F	Flexible Closed Cell	NA	1.5"	1.5"	2"	2"	2"
Heat Pump Piping Operating <50°F	Flexible Closed Cell	NA	1.5"	1.5"	1.5"	1.5"	1.5"
Refrigerant Suction	Flexible Closed Cell	NA	1.0"	1.0"	1.5"	1.5"	1.5"

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1–GENERAL

1.01 SCOPE

- A. This section contains specifications for all refrigerant piping for this project. Included are the following topics:
 1. Refrigerant piping.
 2. Refrigerant piping accessories.
 3. Refrigerant.

1.02 REFERENCE

- A. Applicable provisions of Division 01 govern work under this section.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 1. ANSI B16.22–Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 2. ASTM B88–Seamless Copper Water Tube.
 3. ASTM B280–Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 4. ASHRAE 15–Safety Code for Mechanical Refrigeration.
 5. NFPA 70–National Electric Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

1.05 COPPER TUBE

- A. Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

1.06 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

- B. Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16-inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow observation to verify products.

1.08 DESIGN CRITERIA

- A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

PART 2-PRODUCTS

2.01 REFRIGERANT PIPING

- A. ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.
- B. Precharged tubing line sets may be used on systems 3 1/2 tons and less in size.

2.02 REFRIGERANT PIPING ACCESSORIES

- A. Acceptable manufacturers are Sporlan, Alco, or equal.

- B. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225°F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225°F.
- C. Flexible Pipe Connectors: Double braided bronze hose flexible pipe connectors with solder end connections.
- D. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.
- E. Sight Glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.
- F. Solenoid Valves: Two-way, normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.
- G. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.
- H. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.
- I. Charging Valves: Provide 1/4-inch SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.
- J. Check Valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

2.03 REFRIGERANT

- A. Refrigerant shall be R410A: Difluoromethane/Pentafluoroethane mixture in accordance with ASHRAE 34.

PART 3-EXECUTION

3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

3.02 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- C. Do not install piping running through any elevator shaft, public stairway, stair landing, or means of egress.
- D. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.03 REFRIGERANT PIPING

- A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the 2017 Ohio Mechanical Code and the 2015 International Mechanical Code with amendments.
- B. All brazing filler metals shall have a melting temperature above 1400°F and contain a minimum of 6% silver.
- C. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.
- D. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- E. Systems erected on site which use A1 refrigerants and no piping larger than 0.62-inch in diameter shall be leak tested with refrigerant in accordance with ASHRAE 15 as follows. All other systems shall be leak tested with dry nitrogen or nonflammable, nonreactive, dried gas in accordance with ASHRAE 15. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.
- F. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
- G. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of

refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

3.04 REFRIGERANT PIPING ACCESSORIES

- A. Install accessories in accordance with the manufacturer's written instructions and recommendations.

END OF SECTION

SECTION 23 31 00

DUCTWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Duct Pressure/System Class.
 - 2. Duct Materials.
 - 3. Fasteners, Hangers and Supports.
 - 4. Duct Sealants and Gaskets.
 - 5. Ductwork Fabrication.

1.02 REFERENCES

- A. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Provide layout drawing for review prior to ductwork fabrication. Layout drawings shall be coordinated between all other trades prior to review.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00–Contract Closeout.
- B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain recommended minimum temperatures during and after installation of duct sealants.

- C. Ductwork shall be stored indoors or in durable, waterproof, abovegrade packing.

PART 2–PRODUCTS

2.01 DUCT PRESSURE/SYSTEM CLASS

- A. Ductwork shall be constructed to the static pressure class as shown below, unless otherwise noted: Exhaust air ductwork: 2-inch negative pressure class.

2.02 DUCT MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge, or heavier, except for round ductwork 12 inches and smaller shall be 26 gauge where allowed by SMACNA.
- B. Aluminum ducts shall be ASTM B209, Type 3003-H14 aluminum, minimum 0.025-inch thick, of alloy 3003 H-14, capable of double seaming without fracture.

2.03 FASTENERS, HANGERS, AND SUPPORTS

- A. Ductwork shall be supported in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible. Secure wire method of support is not acceptable.
- B. Inserts and Fasteners:
 - 1. Concrete inserts installed prior to pouring shall be manufactured inserts.
 - 2. Concrete fasteners installed after pouring shall be epoxy-type.
 - 3. Fasteners to ductwork shall be 316 stainless steel unless otherwise indicated.
- C. Hangers:
 - 1. Strip hangers shall be galvanized steel.
 - 2. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts or 316 stainless steel for ducts other than galvanized. Rods shall be continuously threaded.
- D. Supports:
 - 1. Duct support material shall be galvanized steel for galvanized duct. Material for supports in corrosive spaces shall be electro-galvanized.
 - 2. Acceptable supports for trapeze hangers are steel angles or uni-strut. Exposed ductwork shall be supported by steel angle supports painted to match duct.
 - 3. Riser supports shall be angles or channels secured to the sides of the duct with welds or fasteners.

2.04 DUCT SEALANTS AND GASKETS

- A. Duct sealant shall be United McGill–United Duct Sealer, or equal for indoor applications and United McGill–Uni-Weather Duct Sealer, or equal for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- B. Gaskets at flanged joints shall be butyl rubber or EPDM.

2.05 DUCTWORK FABRICATION

- A. Rectangular Field and Shop Fabricated Ductwork:
 - 1. Fabricate and support in accordance with SMACNA–Duct Construction Standards–Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.
 - 2. Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 23 33 00–Air Duct Accessories.
 - 3. Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible; maximum 30 degree divergence upstream of equipment and 45 degree convergence downstream.
 - 4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets, unless otherwise noted.
 - 5. Provide reinforcement and rigidity required for pressure class.
 - 6. Provide cross bracing or cross beading on duct sides larger than 18 inches.
 - 7. Seal all joints airtight with gaskets and sealants.

- B. Round Manufactured Ductwork and Fittings:
 - 1. Fabricate and support in accordance with SMACNA–Duct Construction Standards–Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.
 - 2. Ductwork shall be fabricated spiral seam round.
 - 3. Ductwork shall be constructed with locktight spiral grooved seams, gored elbows with centerline radius of 1 1/2 times the duct diameter, and male/female fittings. Conical tees, conical 45 degree laterals, conical bellmouth taps, and fittings shall be used.
 - 4. Seal all joints airtight with gaskets and sealants.
 - 5. Where grilles and registers are shown to be tapped into ductwork sides, the entire assembly including the round duct section and the rectangular tap shall be fully welded and provided by the manufacturer.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer’s instructions.

- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible.

- C. Duct sizes are inside clear dimensions.

- D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.

- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross-section, offsets, etc., to avoid interference with other equipment and supports.

- F. Use double nuts and lock washers on threaded rod supports.

- G. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- H. Provide an experienced installer to go through the air distribution system with the balancer.
- I. Any modifications to the ductwork shown on the drawings must be reviewed by ENGINEER prior to installation.
- J. The weight of the ductwork shall be supported independently of connected equipment.
- K. Inserts shall be coordinated with CONTRACTOR for installation in concrete.
- L. Where ducts pass through non-fire rated partitions in interior or exterior walls, provide stainless steel flange on four sides on both sides of partition concealing opening. Flange shall overlap opening all around by 2 inches. Fill space with insulation if duct is insulated on either side of partition.

3.02 CLEANING AND PROTECTION

- A. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Duct test holes.
 - 2. Flexible duct connections.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.
 - 2. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.
 - 3. UL 33–Heat Responsive Links for Fire-Protection Service.
 - 4. UL 555–Fire Dampers and Ceiling Dampers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Damper submittals shall include actual pressure drop, free area, and torque requirements for each type of damper provided.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00–Contract Closeout.
- B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturers recommendations and Section 01 60 00–Materials and Equipment.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

PART 2–PRODUCTS

2.01 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps. Coordinate test hole height with insulation thickness.

2.02 FLEXIBLE DUCT CONNECTIONS

- A. Flexible duct connections in unrated spaces shall be Ventfabrics, Inc. “Ventglas®”, or equal, neoprene-coated glass fabric. Fabric shall be suitable for continuous operation up to 200°F. Fabric shall have zero leakage at ±10 inches water column.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer’s instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards–Metal and Flexible. Refer to Section 23 31 00–Ductwork for duct construction and pressure class.
- B. Division 23 shall be responsible for coordinating with testing and balancing agency and providing test holes in all locations required for testing and balancing agency to complete their scope of work.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Ceiling or cabinet fans.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 1. AMCA 99–Standards Handbook.
 2. AMCA 210–Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 3. AMCA 300–Reverberant Room Method for Sound Testing of Fans.
 4. AMCA 301–Method for Calculating Fan Sound Ratings from Laboratory Test Data.
 5. ASTM B117–Standard Practice for Operating Salt Spray (Fog) Apparatus.
 6. NFPA 70–National Electrical Code.
 7. NEMA MG 1–Motors and Generators.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Fans shall bear AMCA-certified rating seals.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

- C. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts and bearings shall be protected from weather and dust.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

PART 2--PRODUCTS

2.01 CEILING FANS OR CABINET FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Fans shall have acoustically insulated housings and shall have maximum sound level rating not to exceed 4.0 sones in accordance with AMCA Bulletin 300-74. Fans shall bear the AMCA-certified ratings and seal for air capacity, sound, and UL label.

- C. Unit shall be equipped with integral chatter proof backdraft damper.
- D. Fans shall have centrifugal wheel with inlet perpendicular to grille. Ceiling grille shall be aerodynamically designed and shall provide 80% free area.
- E. Terminal box shall be furnished with cord, plug, and receptacle inside housing. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motor speed shall not exceed 1,100 rpm.
- F. Fan shall be mounted on vibration isolators furnished by fan manufacturer.
- G. Manufacturer shall furnish line voltage internally-mounted and wired variable speed controller for fan. Controller shall be used for balancing only and shall be inaccessible to room occupants unless otherwise indicated on the drawings. The fan motor shall be open drip proof as indicated on Drawings. Starters and disconnects shall be provided as noted on equipment schedules.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Install units with vibration isolators as recommended or supplied by manufacturer.
- D. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00–Air Duct Accessories.
- E. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.
- F. Provide all mounting hardware and accessories necessary for complete installation.
- G. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- H. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of the OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

- I. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR CONDITIONERS AND HEAT PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Split systems (SS).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 1. ASHRAE 15–Safety Code for Mechanical Refrigeration.
 2. ASHRAE 62–Ventilation for Acceptable Indoor Air Quality.
 3. ASHRAE 90A–Energy Conservation in New Building Design.
 4. NFPA 70–National Electrical Code.
 5. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.
 6. UL900–Test Performance for Air Filter Units.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Direct expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's

performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

- C. Project specific wiring diagrams for power, signal and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

PART 2-PRODUCTS

2.01 SPLIT SYSTEM (SS)

- A. Acceptable manufacturers are Daikin, Sanyo, or Mitsubishi.
- B. General:
 - 1. Split system unit shall be an indoor recessed ceiling-mounted evaporator/blower section and matching outdoor condensing section.
 - 2. Systems shall bear the ARI label showing that the system is ARI 210 or 240, and 270 Certified. Systems shall be listed by ETL Testing Laboratories and bear the

ETL label. Matching systems shall meet or exceed the minimum Federally mandated Seasonal Energy Efficiency Rating (SEER) of 13, as certified by the ARI testing programs.

3. Matching indoor and outdoor sections shall be connected by deoxidized, annealed refrigerant copper tubing, type "L" cleaned and capped. All systems shall have flared refrigeration connections on both indoor and outdoor sections.
 4. Systems indoor and outdoor sections shall be completely factory assembled and wired with a precharge of refrigerant. A single power source shall provide voltage to both the outdoor and indoor units. Electrical wire and connections to outdoor section and between indoor and outdoor sections shall be sized, installed and grounded by the installer in conformance with the National Electrical Code (NEC), local codes, as well as manufacturer's instructions.
 5. System shall be equipped with a microprocessor control system with an infrared remote controller with LCD display, that provides access to all system functions, and transmits room conditions and programs to the indoor microprocessor every 3 minutes. Infrared remote controller shall be capable of operating system mounted up to 26 feet from the indoor section according to manufacturer's recommendations and instructions. System shall have the capability of continuous operation in the case of a lost or damaged remote controller, utilizing a factory-installed integral manual switch in conjunction with the system microprocessor.
- C. System Infrared Remote Controller: Controller shall include system mode selection, programmable temperature control, 24-hour programmable timer, automatic three-speed indoor fan speed control, constant fan speed selection, night setback mode, user selectable room temperature sensor located on either infrared remote controller or indoor unit multiple system control using a single controller. Provide lockable remote controller bracket.
- D. Outdoor Condensing Section:
1. Outdoor condensing section shall be factory assembled, wired, piped, and precharged with a start-up amount of R-410a refrigerant.
 2. Unit shall be constructed of G90 galvanized steel with corrosion-inhibiting, acrylic, baked-on enamel finish.
 3. Unit shall be furnished with a high-efficiency, rotary compressor with internal overload protection, mounted with vibration isolators to reduce noise and vibration.
 4. Condenser coil heat exchanger shall be constructed of nonferrous rifled copper tubing with enhanced aluminum slit fins mechanically bonded to the copper. A suction line accumulator, a coil temperature sensor, and cap tube metering device shall be factory installed.
 5. Fan motor shall be direct drive with internal overload protection, permanent lubrication, with propeller-type fan, mounted for horizontal air discharge.
 6. Brass valves with refrigeration flare connections and flare nuts and service ports shall be factory mounted prior to shipment for installation.
 7. Low ambient outdoor section shall contain a printed circuit board, factory mounted and wired, to assist in control of low ambient operation. Unit shall be able to operate in the A/C mode down to 0°F outdoor temperature. A factory-installed 20-watt crankcase heater shall provide additional compressor protection.
- E. Indoor Evaporator Section:
1. Indoor section shall be exposed ceiling mount type with single direction airflow, factory assembled and wired.
 2. Unit shall contain an evaporator heat exchanger constructed of nonferrous, rifled copper tubing with enhanced aluminum slit fans, mechanically bonded to the copper.

3. A single centrifugal blower wheel, statically and dynamically balanced shall be attached to a single direct-drive PSC fan motor with overload protection, permanent lubrication, and multispeed capability.
4. Unit shall contain a printed circuit board with a control circuit fuse and microprocessor, factory mounted and wired, that receives and processes all commands and transmissions from the system Infrared Remote Controller. Indoor unit shall also contain an Operation Switch with visible lamps for operation, standby and timer functions, as well as a system test switch and manual ON/OFF switch.
5. Unit shall contain an air sensor thermistor, a coil-freeze safety thermistor to prevent freeze-up, a factory-installed condensate drain pump, drain pan, hose and fitting, and refrigeration line connections with flare nuts.
6. Indoor section shall be provided with factory assembled supply and return air grille with a motorized louver/flap on the supply air opening. The motorized louver/flap, controlled by the infrared remote controller, shall provide automatic, full-oscillating supply airflow, as well as being capable of being placed in a set, stationary position.
7. Unit shall also contain adjustable horizontal air louvers to provide user defined directional airflow. Indoor unit will be furnished with an in-ceiling plenum which surrounds the evaporator coil section.
8. Unit shall be furnished with antimold, poly type washable air filters that can be removed without removing indoor unit casing. Indoor unit shall be powered by voltage from the matching outdoor unit.

2.02 HEAT PUMPS (SS)

- A. Indoor Unit: The indoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls.
- B. Unit Cabinet:
 1. The drain and refrigerant piping shall be accessible from six positions for flexible installation.
 2. The cabinet shall be supplied with a mounting plate to be installed onto a wall.
- C. Fan:
 1. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor.
 2. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.
 3. Fan shall provide five speeds and auto settings.
- D. Filter: The return air filter provided will be a mildew resistant, removable and washable filter.
- E. Coil:
 1. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.
 2. All tube joints shall be brazed with silver alloy or phos-copper.
 3. All coils shall be factory pressure tested.
 4. Condensate pan shall be provided under the coil with a drain connection.
- F. Electrical: Electrical characteristics shall be in accordance with the schedule on the drawings.

- G. Control:
1. The unit shall have a backlit, wireless remote infra-red controller capable to operate the system. It shall have Cooling Operation, Heating Operation, Automatic Operation, Dry Operation and Fan Only Operation.
 2. The controller shall consist of an On/Off Power switch, Mode Selector, Fan Setting, Swing Louver, On/Off Timer Setting, Temperature Adjustment, °C or °F Temperature Display, Comfort Mode, Econo Mode, and Powerful Operation.
 3. The controller shall be able to display two-digit fault codes extracted from the indoor unit to aid in troubleshooting.
 4. Temperature range on the remote control shall be 64°F to 90°F in COOL mode, 50°F to 86°F in HEAT mode, and 64°F to 86°F in AUTO mode.
 5. The indoor unit microprocessor shall have the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote control.
 6. The unit shall also have the capability to connect to a smart-device app via wireless adapter.
- H. Outdoor Unit
1. General: The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be complete factory assembled and pre-wired with all necessary electronic and refrigerant controls. The outdoor shall be controlled by a microprocessor and dedicated EEV's shall be provided for capacity control during part load of the indoor unit.
 2. Unit Cabinet:
 - a. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
 - b. The outdoor unit will come furnished with mounting bracket.
 3. Fan:
 - a. The fan shall be a direct drive, propeller type fan.
 - b. The motor shall be inverter driven, permanently lubricated type bearings, inherent.
 - c. A fan guard is provided on the outdoor unit to prevent contact with fan operation.
 - d. Airflow shall be horizontal discharge.
 4. Coil:
 - a. The outdoor coil shall be nonferrous construction with corrugated fin tube.
 - b. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1, rated for up to 1000 hours salt spray.
 - c. Refrigerant flow from the condenser will be controlled via a metering device.
 - d. Unit shall be capable of providing automatic defrost to remove any frost from the outdoor unit allowing the system to maintain heating capacity.
 5. Compressor:
 - a. The outdoor compressor shall be variable speed swing inverter-driven.
 - b. The outdoor unit shall have an accumulator and four-way reversing valve.
 - c. The compressor shall have an internal thermal overload.
 - d. The compressor shall have a quick-warming function to prevent pumping liquid refrigerant in low-ambient conditions.
 6. Electrical: Electrical characteristics shall be in accordance with the schedule on the drawings.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Pipe and trap condensate to grade in accordance with these specifications and Drawings
- D. Protect installed products until completion of project.
- E. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- F. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of the OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- G. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

3.04 CLEANING

- A. Unit shall be cleaned and filters shall be cleaned prior to final acceptance by OWNER.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Electric Unit Heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ARI 410–Forced Circulation Air-Cooling and Air-Heating Coils.
 - 2. NFPA 70–National Electrical Code.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Electrical components shall be UL listed for the service specified.
- C. Electrical components and work shall be in accordance with the National Electrical Code.
- D. Coil performance shall be certified in accordance with ARI 410.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

PART 2-PRODUCTS

2.01 ELECTRIC UNIT HEATERS

- A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.
- B. All electric unit heaters shall be factory-assembled and tested.
- C. Electric Wall Heaters (EWH):
 - 1. Acceptable manufacturer is QMark, or equal.
 - 2. Furnish and install a steel cabinet for surface mounting on a standard block wall as shown on drawings. Provide a cabinet with 16 gauge steel grille bars and finished in baked enamel.
 - 3. Provide a direct-drive propeller fan and permanently lubricated totally enclosed motor.
 - 4. Provide steel-finned metal sheath electric heating elements.
 - 5. Provide manual reset thermal overheat protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may

videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

- E. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 70–National Electrical Code (NEC).
- B. ANSI/IEEE C2–National Electrical Safety Code.

1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.
- C. Hazardous or classified locations, where referenced in the Specifications or on the Drawings, shall be as defined in the NEC.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be paid by CONTRACTOR.

1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and

interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and Specifications. All cases of apparent conflicts between the Drawings, Specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, handhole sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein including, but not limited to:
 - 1. All miscellaneous equipment coordination and related appurtenances required by power company.
 - 2. 480-volt, three-phase, 4-wire service entrance conductors.
 - 3. Feeders, branch wiring, and electrical distribution equipment.
 - 4. All control wiring.
 - 5. Access panels and access doors for access to equipment installed by Division 26.
 - 6. Wiring between system components if equipment is not prewired.
 - 7. Lighting fixtures, lighting controls, and associated wiring.
 - 8. Support system design and supports for electrical raceways.
 - 9. Code-required disconnects.
- B. Provide a standby power system consisting of components indicated on the Drawings (see Section 26 32 13–Standby Power System and Section 26 36 23–Automatic Transfer Switches).
- C. CONTRACTOR shall connect all equipment furnished by other Divisions consisting of components indicated on the Drawings or specified herein.
- D. Provide balancing and adjusting of electrical loads.
- E. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.

- F. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.
- G. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

- A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with ENGINEER as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The Drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

- A. Record drawings of existing underground utilities are not available for this facility. CONTRACTOR shall excavate and verify the location of all underground utilities prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground utilities to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by

ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:

1. Electrical interconnection wiring diagrams; see Section 26 24 19–Motor Control and Section 26 09 00–Controls and Instrumentation.
 2. Major feeder routing in plan and elevation, including service entrance raceways and cable.
 3. Equipment room layouts showing exact locations and arrangements of equipment, conduit, wiring, etc., and clearances.
- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
1. Proper sizes and capacities.
 2. That the item will fit in the available space in the manner that will allow proper service.
 3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01–General Requirements.

PART 2–PRODUCTS

2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, motor control centers, motor starters, VFDs, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, explosionproof, dustproof, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of

substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
 - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
 - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
 - c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
 2. Materials of construction.
 3. Gauges, weights, and sizes of all portions and component parts.
 4. Design arrangements, methods of construction, and workmanship.
 5. Coatings, finishes, and durability of wearing parts.
 6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
 7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

PART 3-EXECUTION

3.01 UTILITY SERVICES

- A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 26 21 00-Electrical Service System of these specifications.
- B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included in the Base Bid.
- C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:
 1. No permanent service shall be available until structure is enclosed, watertight, and heated.
 2. Only permanently connected and protected circuits and outlets shall be available.
 3. Temporary wiring shall not be connected to permanent distribution equipment.
 4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.
- D. It shall be CONTRACTOR's responsibility to police this situation and protect its equipment.

3.02 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.
- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.03 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, MCCs, disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. Where louvers are provided in MCCs, or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses (interior and exterior fixtures) shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.04 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.
- B. Concrete shall comply with Section 03 30 00—Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.05 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.

- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.06 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

3.07 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.
- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.08 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, VFDs, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.
- C. Where starters, VFDs, or other devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters or VFDs as specified herein or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all power and control wiring. CONTRACTOR shall provide raceways for all wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.

- H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

3.09 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33–Conduit for additional requirements associated with PVC conduit installed in earth.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.
- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 31 for rock excavation requirements.

3.10 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.11 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.

- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the Drawings is approximate.
- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance shall be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.
- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

3.12 AREA CLASSIFICATION

- A. As noted on the Drawings.
- B. Where referenced herein, damp and wet locations shall include, but not be limited to, all NEMA 4X areas, structures and areas below grade, and exterior locations.

END OF SECTION

SECTION 26 05 19

WIRE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wire.
 - 2. Terminal blocks and accessories.
 - 3. Wiring connections and terminations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, which has been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00–Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2-PRODUCTS

2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed, except where specified below for VFDs.
- B. Motor circuit branch wiring and associated control wiring:
 - 1. Insulation type shall be THHN (indoors, nonVFD application).
 - 2. Minimum size for motor control wiring shall be 14 AWG.
 - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be multiconductor, shielded consisting of stranded, tinned copper conductors, full size ground, copper shield, XLPE insulation, and 1000 V rating. Conductor sizes 12 AWG through 2 AWG shall have full-size insulated ground conductor and 85% tinned copper braid shield. Cable shall be Belden, or equal, 29502 through 29507 for sizes 12 AWG through 2 AWG.
- D. All wiring within control panels, supervisory control centers, and motor control centers that does not extend outside of the enclosure or the motor control center bucket shall be insulation-type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be XHHW-2.
- F. Refer to Section 26 05 53-Electrical Identification for required wire insulation color coding and conductor labeling requirements. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. Branch circuit wiring for exterior lights in excess of 75 feet shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed,

temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.

- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

2.03 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of one-hole copper compression lugs for 6 AWG and larger, split-bolt connector for 8 AWG and smaller, and motor-lead pigtail splice kit. Individual components shall be as follows:
 - 1. Split-bolt connectors shall be for use with copper conductors only.
 - 2. One-hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
 - 3. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Pigtail splice kit shall have locking pins for conductors 2 AWG and larger. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.
- D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy UGSKIT2 or equal. Splice shall be made with crimp tool by manufacturer that allows expanded conductor ranges. Splice insulation component shall be Raychem heavy-wall, low-voltage tubing, type WCSM, or equal.

2.04 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed or UL recognized under UL 467, UL 486E, UL1059, and UL 1953 (power terminals only).
- B. Power Terminal Blocks: Unit construction type, closed-back type, tin-plated copper, with tubular pressure screw connectors, rated 600 volts as manufactured by Allen-Bradley 1492-PDL, or equal.
- C. 600-Volt Fuse Holders: Fuse holders for circuit rated up to 30 amps and 600 volts AC shall be finger safe, UL Listed, DIN-rail mountable, and shall include blown-fuse indicating lights. Fuse holders shall be as manufactured by Allen-Bradley Bulletin 1492-FB, or equal.
- D. Signal and Control Terminal Blocks:
 - 1. General-Purpose Terminal Blocks:
 - a. Terminal blocks shall be rated up to 600 volts AC/DC.

- b. Terminal blocks shall accept center-mounted jumper bars without increasing the installed space.
 - c. Terminal blocks shall be Allen-Bradley Bulletin 1492-J, or equal.
 - d. Terminal block color shall be gray.
2. Grounding Terminal Blocks:
 - a. Terminal blocks shall be Allen-Bradley Bulletin 1492-JG, or equal.
 - b. Terminal block color shall be green/yellow.
 3. Disconnect-type Terminal Blocks (300-Volt Class):
 - a. Terminal blocks shall be feed-through type with a knife-blade disconnect.
 - b. Terminal blocks shall be Allen-Bradley Bulletin 1492-JKD, or equal, depending on the application.
 - c. Terminal block color shall be gray.
 4. Fuse-type Terminal Blocks with Indicator (300-Volt Class):
 - a. Terminal blocks for applications from 100 to 300 volts AC shall be Allen-Bradley Bulletin 1492-H4, or equal, with neon blown-fuse indicator.
 - b. Terminal blocks for applications from 10 to 50 volts AC/DC shall be Allen-Bradley Bulletin 1492-H5, or equal, with LED blown-fuse indicator.
 - c. Terminal block color shall be black.
 5. Terminal Blocks for Power Meters and Current Transformers: Provide test-disconnect terminal blocks for disconnecting, shorting, and testing current transformers and for disconnecting and testing voltage sensing inputs. Provide test-disconnect terminals for individual current transformer or voltage sensing installations, and provide a group of terminals for all current transformer and voltage sensing inputs for each power meter installation.
 - a. Provide a pair of terminal blocks for each current transformer including one feed-through terminal block, one sliding disconnect terminal block with a cross-connection short-circuit slider. The pair of terminal blocks shall include the following:
 - (1) Feed-through terminal block shall be Weidmüller Model WTD 6/1 EN, or equal.
 - (2) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
 - (3) Short-circuit slider shall be Weidmüller Model WKS 2/2, or equal. The short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.
 - (4) Provide two cross-connection sliders Weidmüller Model STB, or equal, with connecting sleeves Weidmüller Model VH, or equal. Provide one slider fixing screw Weidmüller Model BS, or equal. Connecting sleeves and fixing screws shall be color coded for each current transformer.
 - b. Provide disconnecting terminal blocks for each voltage sensing and neutral connection. The terminal blocks shall include the following:
 - (1) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
 - (2) Provide one cross-connection slider Weidmüller Model STB, or equal, with connecting sleeve Weidmüller Model VH, or equal, for each voltage sensing and neutral connection terminal block. Provide one slider fixing screw Weidmüller Model BS, or equal. The neutral connecting sleeve shall be a different color than the voltage sensing connecting sleeves.
 - c. Terminal block colors shall be gray. Provide end plates and end brackets as required to complete the test-disconnect terminal block assembly.

6. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
 7. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
 8. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
 9. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
 10. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
 11. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.
- E. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

PART 3—EXECUTION

3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.
- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in the same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, motor control centers, panelboards, control panels, equipment, etc. No splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, control panels, MCCs, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.

- J. Terminate all wiring on terminal blocks in control panels, starter cubicles, and similar equipment. This shall include all spare or unused wires.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder. Daisy chaining of neutrals will not be allowed.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) and intrinsically safe wiring must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices and communication wiring (i.e., Ethernet, etc.). Analog wiring shall be in a conduit separate from all other wiring. Intrinsically safe wiring shall be separated and identified in accordance with Article 504 of the NEC.
- N. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.
- O. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- P. Thoroughly clean wires before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- R. Terminate spare conductors within equipment, MCCs, control panels, etc., on terminal strips and label as “SPARE.” Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as “SPARE.” All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53–Electrical Identification, for additional requirements.
- S. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit.
- C. Control wiring for HVAC and lighting equipment connected to emergency power shall be installed in conduit.
- D. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- E. Low-voltage cable splices shall only be allowed in junction boxes.

3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors No. 6 AWG and larger shall be pulled into conduits by hand or by utilizing a tugger with built-in tension meter. Other motorized machines of any type are not allowed for any wire pulling. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.
- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the Drawings.

3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 2 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.
- E. For current transformer shorting terminal blocks, the short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.

- F. Provide terminal blocks where required to extend current transformer lead wires. Terminal blocks shall be mounted in a small junction box or have a removeable barrier covering the terminals to prohibit wire removal without first opening the enclosure or removing the barrier. Provide a nameplate on the junction box/barrier reading: "DANGER: DO NOT DISCONNECT CT WIRES UNDER LOAD."

3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and Drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.
- E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- F. The transformer and feeder to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
 - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.

2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as instruments, network, etc.

END OF SECTION

SECTION 26 05 23

INSTRUMENT AND COMMUNICATION WIRE AND CABLE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

PART 2-PRODUCTS

2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded pair cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded cables shall be Belden 9316, or equal.

2.02 INDUSTRIAL ETHERNET CABLE

- A. 600-Volt Rated Shielded Cable:
 - 1. For communication with plant SCADA Systems and equipment in supervisory control centers, motor control centers, switchgear, switchboards, control panels, etc., over 300 volts, and other areas or raceways with power wiring over 300 volts, provide 600-volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 - 2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.34 inches. Cable shall be CMR rated, UL listed, 600 V UL AWM rated, and be Belden 7953A or equal.
 - 3. Cable jacket color shall be red.
 - 4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- B. 300-Volt Rated Unshielded Cable:
 - 1. For communication with plant SCADA Systems and equipment in communication racks, supervisory control centers, and control panels without VFDs, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300-volt-rated, 4-pair, unshielded (U/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 - 2. Industrial Ethernet cable shall be minimum 23 AWG with PVC jacket. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.24 inches. Cable shall be CMR rated, UL listed, and shall be Systimax Solutions 1071E, or equal.
 - 3. Cable jacket color shall be light blue.

4. Provide unshielded RJ45 connectors on both ends of each cable.
- C. 300-Volt Rated Shielded Cable:
1. For communication with plant SCADA Systems and equipment in supervisory control centers, motor control centers, switchgear, switchboards, control panels, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.29 inches. Cable shall be CMR rated, UL listed, and shall be Systimax Solutions 1271B, or equal.
- D. Patch cables shall be provided premanufactured by the cable manufacturer or connector manufacturer in sufficient length to connect the associated equipment to any port on the equipment, patch panel, or switch. Field-attached plugs shall be insulation displacement type and shall be by the same manufacturer as the cable.

PART 3-EXECUTION

3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair and industrial Ethernet cabling specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.
- B. Armor may be necessary on instrument cables installed in in nonmagnetic electrical ducts:
 1. For electronic instrument wiring there shall be a steel wire armor of 24 gauge AISI 1006 soft annealed steel wire covering the inner jacket.
 2. The armor shall be covered by a flame-retardant and weather- and ultraviolet-resistant PVC, outer jacket 35 mil minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cables.

3.02 GROUNDING

- A. The shielded connection for shielded network cabling shall be connected at the network switch or patch panel and not at the field device connection. Ground network switches accepting shielded network cables.
- B. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- C. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- D. All shields must be grounded.

- E. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.

END OF SECTION

SECTION 26 05 26

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Power system grounding.
 - 2. Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper-bonded, 5/8-inch diameter; minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type by Cadweld, compression type by ABB (Thomas & Betts), or equal. Compression connectors shall be prefilled with an oxide inhibitor.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.
- B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.

- D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, structural reinforcing bars, and lightning protection system ground conductors using suitable ground clamps.
- E. Ground system, transformer neutrals, and equipment as required by code and local ordinances.
- F. All feeder neutrals shall be connected to neutral at only one point in the MCC.
- G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- H. A minimum of three ground rods at 15-foot separations near service or feeder entrance of each building shall be provided. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- I. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.
- J. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on the drawings.
- K. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- L. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- M. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers and 4-wire standby generators.
- N. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for additional grounding requirements.

3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point “Fall-of-Potential” test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient “open earth” area to use the three-point

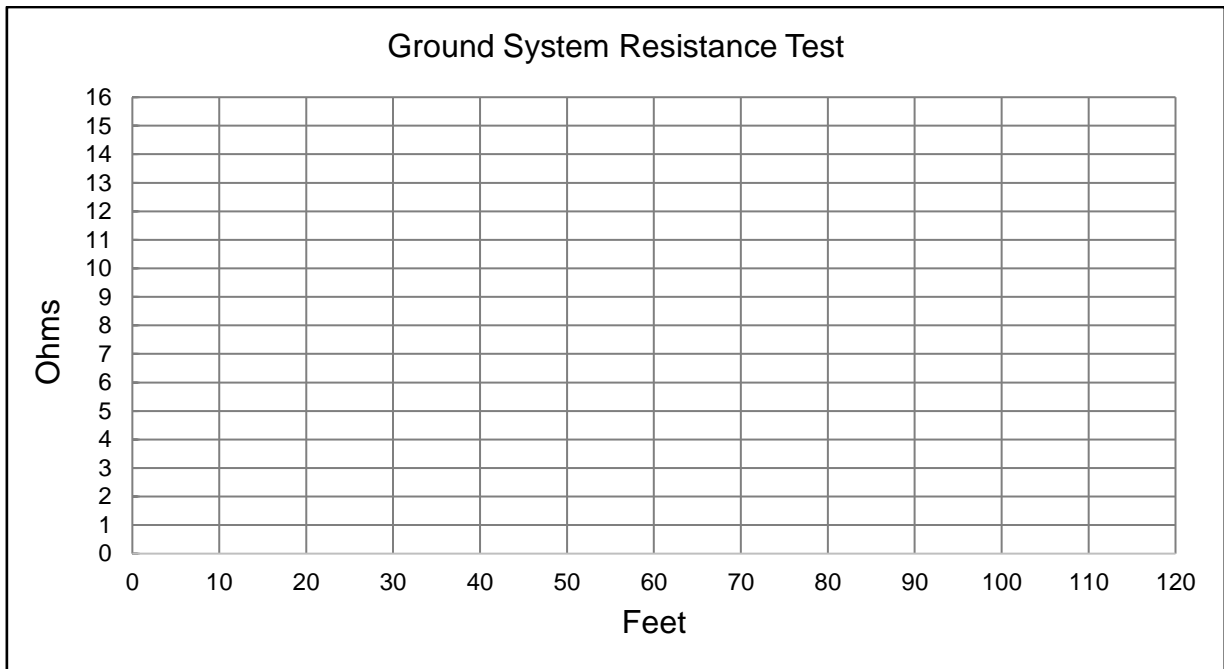
Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER or OWNER. ENGINEER shall be notified a minimum of 72 hours in advance of all ground system testing.

- C. The test meter shall be Associated Research Vibroground test set with null balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test equipment.
- D. Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached Form 26 05 26. Each ground grid shall have a form submitted.

END OF SECTION

GROUND ROD RESISTANCE TO EARTH TEST RECORD

- 1. DATE _____
- 2. PROJECT NAME _____
- 3. LOCATION OF TEST _____
- 4. GROUND ROD TYPE _____
DIAMETER _____ LENGTH _____
- 5. TEST METHOD _____
INSTRUMENT TYPE _____
SERIAL NO. _____
- 6. REQUIRED MAXIMUM RESISTANCE TO EARTH _____
- 7. MEASURED RESISTANCE TO EARTH
GROUND ROD SYSTEM _____



TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SECTION 26 05 29
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Conduit and equipment support members.
 - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
 - 1. 316 stainless steel in exterior locations and Class I locations.
 - 2. Hot-dipped, galvanized steel in all other areas.
- B. Hardware:
 - 1. Stainless steel in exterior locations and Class I locations.
 - 2. Hot-dipped, galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the Drawings to adequately support load.

- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs or suspended ceiling grid bridge supports as specified in other technical sections.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. The ends of all support members shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. In wet locations, install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with standoffs and caulk.
- J. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
- K. Do not use chain, wire rope, or perforated strap hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 26 05 33

CONDUIT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Rigid metal conduit and fittings.
 - 2. Rigid aluminum conduit and fittings.
 - 3. Polyvinyl chloride conduit and fittings.
 - 4. Liquidtight flexible metal conduit and fittings.
 - 5. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI C80.1–Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.5–Electrical Rigid Aluminum Conduit (ERAC).
- C. ANSI/NEMA FB 1–Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- D. NEMA RN 1–Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical materials, which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material, and shall not have been stored outdoors or exposed to weather.
- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

PART 2–PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have domed gasketed covers and stainless steel screws. Conduit bodies sizes 1 1/4-inch and larger shall have built-in pulling rollers. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- C. Rigid Aluminum Conduit: ANSI C80.5 and UL6A. Heavy wall.
- D. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size per application.
- E. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. For hazardous locations, fittings and conduit bodies shall meet the requirements of UL 886. Split couplings are not allowed.
- F. Supports: One-hole straps with conduit clamps and backspacers shall be used for surface-mounted conduit. Where standoffs are required, provide conduit clamps and supporting devices as specified in Section 26 05 29–Supporting Devices.

2.02 POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps shall be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

2.03 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
 - 1. Conduit: Spiral-wound, electrogalvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed and be rated for installation in Class I, Division 2, Groups C and D locations. Conduit shall be Liqueflex Type LA, or equal.
 - 2. Fittings: UL listed with thermoplastic elastomer sealing gasket.
 - a. Provide stainless-steel fittings outdoors and in NEMA 4X locations, unless noted otherwise.
 - b. Provide electro-zinc plated steel fittings in all other areas, unless noted otherwise.

2.04 FLEXIBLE CONDUIT COUPLINGS (HAZARDOUS LOCATIONS)

- A. Flexible conduit in hazardous locations shall be liquidtight, stainless steel and be rated for use in Class I locations. Outer braid and end fittings shall be stainless steel with flexible brass inner core. An insulated ground conductor shall be installed in all couplings.
- B. Couplings shall be as manufactured by Crouse Hinds EC Series, or Appleton EX Series.

2.05 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit seal-offs for Class I Locations: Robroy Industries Plasti-Bond Red H₂O_T Series EYS seal fittings and Crouse Hinds “Chico A” sealing compound, Arrow-Hart, or equal.
- B. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, or equal.
- C. Expansion Fittings: Crouse Hinds or Robroy Type XJG (non-hazardous location) or Type UNY/UNF (hazardous location), or equal, for rigid, IMC. Carlon E945 Series, or equal for PVC conduit.
- D. Expansion Deflection Fittings: O-Z type “DX,” Crouse Hinds, type XD (PVC conduit only), or Appleton.
- E. Ground Bushings: Crouse Hinds Model GLL, or equal.

- F. Watertight Hubs: Diecast, insulated and gasketed, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUBXXXDN, Crouse-Hinds Myers Hubs, or equal.
- G. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.
- H. Conduit threads joint compound: Kopr-shield conductive, anti-corrosion joint compound as manufactured by Thomas + Betts, or equal.

PART 3-EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.
- F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal to or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when it will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice. Conduits through roofs shall be rigid metal conduit and be equipped with pitch pockets.
- I. Conduit attached to building surfaces that may be damp or wet shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in

damp and wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp and wet locations.

- J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.

3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Interior conduit shall be run concealed in walls, building cavities, chases, attic spaces, and buried below floor slabs. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.
- B. Conduit may be run exposed on the underside of precast or poured concrete floor slabs or in basements. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over high-temperature machinery nor in contact with such equipment. All conduit shall be run exposed in structures below grade.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inches. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.
- D. PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- E. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, disconnect switches, and all other components of the raceway system.
- F. Where conduits installed through roofs serve heating, ventilating, and air-conditioning equipment, conduits shall not be routed through ductwork or chases; conduits shall penetrate the roof and be equipped with pitch pockets.
- G. Conduits installed for future equipment or electrical work shall be extended 4 inches above finish floor and capped. Conduit ends shall have threaded fittings to accommodate future conduit installation.
- H. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.
- I. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, motor terminators, pump cables, float cables, etc.
- J. Conduit seals shall be provided for intrinsically safe circuits, where conduits pass from the interior to exterior of the building, any conduit entering a wet location.

- K. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- L. All runs of flexible conduit and flexible conduit couplings to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.
- M. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- N. Conduits shall be pitched so that drainage is away from all structures.
- O. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- P. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- Q. Routing of conduits on exterior of buildings shall be reviewed with ENGINEER prior to installation.
- R. Conduits installed in damp and wet locations shall have all threads coated with conduit threads joint compound.

3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.
- B. Conduit penetrations for interior control panels or enclosures containing electronic equipment shall utilize watertight hubs and, shall only enter the side or bottom of the enclosure.
- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes, control panels) shall utilize watertight hubs and enter the bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint, for conduits protruding from duct banks that are routed above grade and into structures, and for conduits protruding from earth.
- E. All conduits that protrude from poured concrete shall be rigid steel conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete (both sides).
- F. Conduits passing through masonry, concrete, or similar construction shall be cast in place using rigid steel conduit extending completely through the construction.

- G. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.
- H. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.

3.04 CONDUIT INSTALLATION IN HAZARDOUS LOCATIONS

- A. All conduits installed in or passing through “hazardous locations” as defined by the NEC, NFPA, or as noted on the drawings, shall be installed with seal-offs as specified herein.
- B. All conduits in hazardous locations shall be installed in accordance with the NEC.
- C. Conduits for intrinsically-safe circuits shall be dedicated to intrinsically-safe wiring. Conduits shall be installed and identified by labeling or color coding in accordance with Article 504 of the NEC.

3.05 CONDUIT INSTALLATION FOR EMERGENCY LIGHTING AND POWER CIRCUITS

- A. All emergency egress lighting and power circuits shall be installed in dedicated conduits.
- B. Conduits for emergency egress lighting and power circuits shall be installed and permanently marked in accordance with the NEC.

3.06 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
 - 1. Rigid steel:
 - a. Structural slabs.
 - b. Interior locations requiring mechanical protection.
 - c. All exposed interior locations.
 - d. All concealed interior locations.
 - e. Class I, Division 2 locations.
 - f. Conduits protruding from concrete.
 - g. Earth where penetrating concrete (minimum 4 feet and maximum 10 feet beyond the below-grade penetration).
 - 2. Rigid aluminum:
 - a. All exposed interior locations.
 - b. Interior locations requiring mechanical protection.
 - c. Exterior locations (except in earth) and locations exposed to weather.
 - d. Class I, Division 1 locations.
 - e. Class I, Division 2 locations.
 - f. All locations where attached to aluminum railings or aluminum structural members.
 - 3. PVC:
 - a. Earth, except within 4 feet of a building or structure footing, wall, or handhole. PVC conduit under pavement or roadways shall be Schedule 80.
 - b. Service entrance ground conductors.
 - c. Buried below slabs on grade.
 - 4. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
 - a. Equipment in wet locations.
 - b. Equipment with sliding bases or flexible positioning.

- c. Equipment with vibration isolation mounting.
- d. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
- e. All pumps and associated equipment.

END OF SECTION

SECTION 26 05 35

BOXES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Switch, outlet, and small junction boxes.
 - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NEMA OS 1–Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. ANSI/NEMA OS 2–Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc. that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Masonry and Partition Boxes: Galvanized steel, nongangable. ABB (Thomas & Betts), MB Series, or equal. Provide number of gangs for devices shown on the drawings.
- B. Cast Boxes: Aluminum or cast ferrous alloy, deep-type, gasketed cover, threaded hubs, Eaton FD Series, or equal.
- C. NEMA 4X Boxes: PVC or FRP, Carlon NS Series, or equal, with proper cover and gasket. 316 stainless steel, Eaton FD Series, or equal, where specified herein.
- D. Covers for switch and outlet boxes used as junction boxes shall have covers that match box type.

2.02 PULL AND JUNCTION BOXES

- A. Cast Boxes: NEMA 250; Type 4, surface-mounted junction box, UL-listed as watertight. Cast aluminum or ferrous alloy box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal. Boxes larger than 12 inches in any dimension shall have hinged cover.
- B. NEMA 4X Boxes: PVC or FRP, Carlon HS Series, or equal with proper cover and gasket. 316 stainless steel with hinged cover, recessed quarter-turn latches, and gasket, Saginaw Control and Engineering Enviroline Series, or equal, where specified herein.
- C. NEMA 12 Boxes: Painted steel with hinged cover, recessed quarter-turn latches, and gasket. Boxes shall be Hoffman Bulletin CW1, or equal.
- D. Where terminal blocks or other devices are mounted in a pull or junction box, provide a 14-gauge steel back panel with a white enamel finish for mounting.
- E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

PART 3–EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on the drawings are approximate. Verify location and size of outlet boxes in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring, separate boxes shall also be provided unless acceptable to ENGINEER. Where acceptable to ENGINEER, combined boxes shall be physically divided to separate the wiring.

- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.
- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces that may be damp or wet shall be spaced to avoid rust and/or corrosion. All boxes in damp and wet locations shall be on 1/2-inch standoffs.

3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit.
- D. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring, wiring for emergency egress lighting, and intrinsically safe wiring shall each have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- G. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- H. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch-square masonry boxes fitted with raised plaster covers. In poured concrete walls belowgrade, use cast boxes.
- I. In unplastered brick or block walls, use masonry boxes.
- J. In metal door frames, use partition boxes.
- K. For weatherproof switches, devices, and exterior fixtures, use cast boxes with proper cover and gasket.
- L. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- M. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- N. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- O. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- D. Refer to Section 26 05 53—Electrical Identification for junction box labeling requirements.
- E. All interior exposed junction and pull boxes shall be NEMA 12, unless noted otherwise.
- F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.
- G. Boxes in hazardous locations shall be rated for Class I, Division 1, Groups C and D locations.

END OF SECTION

SECTION 26 05 44

HANDHOLES

PART 1–GENERAL

1.01 DESCRIPTION

- A. Work Included: Precast polymer concrete handholes.
- B. Related Sections: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A48–Specification for Gray Iron Castings.
- B. ASTM A615–Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- C. ASTM C478–Specification for Precast Reinforced Concrete Manhole Sections.
- D. ASTM D4101–Specification for Polypropylene Injection and Extrusion Materials.
- E. ANSI A14.3–Safety Requirements for Fixed Ladders.
- F. ANSI/SCTE 77–Specification for Underground Enclosure Integrity.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawing submittals shall include the following: Product data (handholes); Manufacturer's technical information for handholes and accessories proposed for use.

PART 2–PRODUCTS

2.01 PRECAST POLYMER CONCRETE HANDHOLES

- A. Material and Construction:
 - 1. Precast polymer concrete.
 - 2. Duct entrances sized and located to suit duct banks.
 - 3. Enclosures, boxes and covers are required to conform to test provisions of ANSI/SCTE 77 for Tier 22 applications.
 - 4. Handholes shall be a minimum of 30 inches deep. Handholes shall be sized in accordance with the NEC.
 - 5. Covers shall have the following stamped logo:

“ELECTRICAL”

6. Handholes shall be Hubbel, Quazite, PG-Style, or equal.
7. Handholes for loop detector lead-in cables only shall be Quazite Model PC1212BA12 with Tier 15-rated, gasketed cover Model PC1212GA00, or equal.

PART 3—EXECUTION

3.01 INSPECTION AND COORDINATION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 HANDHOLE INSTALLATION

- A. Coordinate handhole installation with piping, sheeting, and other underground systems and structures, and locate clear of interferences.
- B. Install handholes where shown and verify locations in field. Perform excavation and backfilling required for installation. Excavation and backfilling shall be in accordance with Section 26 05 00—General Electrical Requirements.
- C. Install handholes on a 3/4-inch crushed stone foundation 1 foot under all handholes, and within 2 feet of handholes. Handhole bases shall be set at the proper grade and carefully leveled and aligned.
- D. All conduits must enter the sides of handholes. Conduits entering the bottom will not be permitted. Conduits shall enter handholes a minimum of 6 inches above bottom of handhole. Provide handhole depth as required. Conduit burial depth shall be 24 inches as specified.
- E. Handholes shall be considered wet locations for purposes of equipment selection.
- F. All conduits shall be pitched so that drainage is towards handholes and away from all structures.

3.03 GRADING AT HANDHOLES

- A. Handholes in unpaved areas shall be built as shown to a rim elevation higher than the original ground. The ground surface shall be graded to drain away from the handhole. Fill shall be placed around handholes to the level of the upper rim of the handhole frame, and the surface evenly graded on a one (vertical) to five (horizontal) slope to surrounding ground, unless otherwise shown.
- B. CONTRACTOR shall be solely responsible for proper height of handholes necessary to reach final grade. ENGINEER's review of shop drawings for handhole components is general in nature, and CONTRACTOR shall provide random length handhole riser sections to adjust handholes to meet field conditions for final grading.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Nameplates.
 - 2. Labeling tags.
 - 3. Wire markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference drawings for type used.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Type “A”:
 - 1. Use:
 - a. Each separately mounted disconnect switch.
 - b. Each device in motor control centers.
 - c. SPD.
 - d. Each device on Supervisory Control Center exterior.
 - e. Cabinets, enclosures, pull, and junction boxes.
 - f. Field devices (flowmeter transmitters, level transmitters, etc.).
 - 2. Size: 2-inch by 3-inch.
 - 3. Material: 2-layer laminated Micarta.
 - 4. Background Color: Black.
 - 5. Character Color: White.
 - 6. Character Size: 1/2-inch.
 - 7. Engraving: See MCC schedule, one-line, and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
 - 8. Mounting Location: Front exterior.
- B. Type “B”:
 - 1. Use: Standby power systems as in “A” above.
 - 2. Size: 2-inch by 3 5/8 inch.
 - 3. Material: 2-layer laminated Micarta.
 - 4. Background Color: Red.
 - 5. Character Color: White.

6. Character Size: 1/4-inch.
7. Engraving: See MCC schedule and one-line for labels, or as requested by ENGINEER.
8. Mounting Location: As requested by ENGINEER.

C. Type "C":

1. Use:
 - a. Motor Control Centers.
 - b. Supervisory Control Centers.
2. Size: 4-inch by 4-inch.
3. Material: 2-layer laminated Micarta.
4. Background Color: Black.
5. Character Color: White.
6. Character Size: 2 1/4-inch.
7. Engraving: Equipment label, Emergency shall be red with white letters. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power Panel).
8. Mounting Location: Equipment: Top wire way.

D. Type "D":

1. Use: Control stations, thermostats, conduit fittings, etc.
2. Size: 3/8-inch by 2-inch.
3. Material: 2-layer laminated Micarta.
4. Background Color: Black.
5. Character Color: White.
6. Character Size: 1/8-inch.
7. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
8. Mounting Location: Device front at top.

2.02 LABELING TAGS

A. Use: Field-Mounted Devices (Level Transmitters, Flow Transmitters, etc.).

1. Size: 2-inch diameter round.
2. Material: 2-layer laminated Micarta.
3. Character Size: 1/8-inch.
4. Engraving: As requested by ENGINEER.

2.03 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.

1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.

B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed circuit directories and schedules in all panels, including, but not limited to, panelboards, where Work is done under this Contract.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Where terminal blocks are factory provided with non-project-specific labels by equipment manufacturers in MCC buckets, combination starters, VFDs, motor control panels, control panels, and similar equipment and are wired to terminal blocks in control panels with project-specific labels, the interconnecting wiring shall be labeled at both ends to match the project-specific terminal blocks in the control panel. Provide an additional label on the end of each wire that is connected to a terminal block with a non-project-specific label to indicate the associated terminal block.
- D. Power Conductor Insulation Color Code:
 - 1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as handholes, junction and pull boxes, panelboards, motor control centers, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
 - 2. 8 AWG and Smaller: Provide conductors with color-coded insulation.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/208 Volts Three-Phase, Four Wire	Grounded Neutral Phase A Phase B Phase C	White* Black Red Blue
277/480 Volts Three-Phase, Four Wire	Grounded Neutral Phase A Phase B Phase C	White* Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		
* When installed as part of a 120-volt or 277-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

E. Control Panel and Field-Installed Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors Neutral	Black White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Blue White with Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g. foreign supply voltages)	Control Circuit Conductor AC Neutral DC Common Ground	Orange White White with Blue Stripe Green
Intrinsically Safe	Control Circuit Conductor DC Common	Light Blue White with Two Light Blue Stripes

F. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as handholes, junction and pull boxes, panelboards, motor control centers, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
 - a. Assign circuit name based on unique device or equipment at load end of circuit.
 - b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

3.03 DATA/VOICE CABLE AND COMMUNICATION EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on both ends of all cables.

- B. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for cable insulation color requirements.

3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent nameplates. Nameplates shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

3.05 CONDUIT FITTINGS IDENTIFICATION

- A. All conduit fittings that contain splices of any kind shall be labeled with permanent nameplates indicating “splice within.” Nameplates shall be clearly visible at location installed. Nameplates shall be fastened to each conduit fitting with heavy duty, UV-resistant, cold weather cable ties.

3.06 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and ampere rating.

3.07 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, transformers, etc.) within enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels. Labels shall be installed on the enclosure back panel and not on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

3.08 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

SECTION 26 09 00

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

- A. Allowances: System Supplier shall include in the Bid the cost of the following items specified in this section. Refer to the individual descriptions listed below for a complete description of the Work required. Item 2.01–SCADA Wireless Access Point and Tablet.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. Section 26 09 10–Controls and Instrumentation Drawings.
 - 3. All other sections of Division 26.

PART 1–GENERAL 1

1.01 SUMMARY..... 1

1.02 SYSTEM DESCRIPTION..... 2

1.03 QUALITY ASSURANCE..... 2

1.04 SUBMITTALS..... 3

1.05 OPERATION AND MAINTENANCE DATA 3

1.06 DELIVERY, STORAGE, AND HANDLING 4

1.07 SYSTEM ENGINEERING 4

1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS 5

1.09 FACTORY ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES 6

1.10 COMMON REQUIREMENTS ALL EQUIPMENT..... 9

1.11 GENERAL CONTROL ALGORITHMS..... 10

1.12 WARRANTY 12

PART 2–PRODUCTS..... 12

2.01 SCADA WIRELESS ACCESS POINT AND TABLET 12

2.02 OPERATOR INTERFACE PANEL (OIP) CONFIGURATION 13

2.03 EQUIPMENT ENCLOSURES 15

2.04 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS..... 17

2.05 UNINTERRUPTIBLE POWER SUPPLIES 19

2.06 INDUSTRIAL CONTROL RELAYS AND CONTACTORS 20

2.07 LUMINESCENT DISSOLVED OXYGEN (DO) MONITORING SYSTEM..... 21

2.08 PH ANALYZER SYSTEM..... 22

2.09 FLOAT SWITCHES..... 23

2.10 OPEN CHANNEL FLOW TRANSMITTERS 24

2.11 MAGNETIC FLOW METERS 24

2.12 SUBMERSIBLE LEVEL TRANSMITTERS 26

2.13 OPERATOR INTERFACE PANEL 26

2.14 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS, INSTRUMENTATION, AND NETWORK EQUIPMENT 27

2.15 INTRINSIC SAFETY BARRIERS 27

2.16 INDUSTRIAL ETHERNET SWITCHES..... 27

2.17 TURBIDITY MONITORING PANEL 28

PART 3-EXECUTION..... 28

3.01	MOTOR CONTROL CENTER 30 (MCC-30) NOTES	28
3.02	SUPERVISORY CONTROL CENTER GENERAL	30
3.03	SUPERVISORY CONTROL CENTER SCC-30.....	31
3.04	PUMP, FLOAT SWITCH, AND TRANSDUCER CABLE JUNCTION BOXES.....	35
3.05	MISSION ALARM SYSTEM.....	35

1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Supervisory Control and Data Acquisition (SCADA) System for the Sycamore Trails Wastewater Treatment Plant.
- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, the SCADA System OIP, hardware, system drawings, system software, new MCCs at the wastewater treatment plant. See Paragraph 1.08 for other System Supplier requirements.
- C. System supplier shall be responsible for all OIP graphics programming.
- D. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- E. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- F. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels.

1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in phases.
 - 1. The first submittal shall include the following:
 - a. Detailed catalog information, descriptive literature, and specifications of hardware and software. All items being provided must be specifically noted on this literature, including all field devices and instruments.
 - b. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
 - c. Overall network schematic showing all controllers and hardware addresses applicable to the system.
 - d. Wiring diagrams for all control panels and MCCs.
 - 2. Subsequent submittals shall include the following:
 - a. Control narratives.
 - b. OIP graphic displays (graphics shall be submitted with adequate time for review and addressing of review comments prior to factory acceptance testing: minimum of four weeks).
 - c. Alarm and status logging format.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply:
 - 1. Manuals shall contain, but not be limited to, the following:
 - a. System Hardware.
 - b. System Software.
 - 2. Hardware section shall include:
 - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
 - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.

- c. Listing of all hardware timers installed in MCCs and SCCs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.
3. Software section shall include:
 - a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software. System techniques description shall include a detailed screen-by-screen description explaining where the various signals originate, how to change equipment setpoints and control modes, how alarms are acknowledged, and how to go from screen to screen. All menu selections and their functions shall also be described in detail.
 - b. Program documentation (i.e., PLCs, OIPs) shall include programs, documentation files, database and configuration as installed. Provide two USB flash drives with this information. Usernames and passwords for all programmable devices (i.e., PLCs, OIPs) shall be turned over to OWNER at the time of final completion.
4. As built drawings shall include all modifications made during startup and checkout. Drawings shall be provided in AutoCAD format (.dwg).

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to SCC components, enclosure, and finish.

1.07 SYSTEM ENGINEERING

- A. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and be in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
 1. PLC system layouts.
 2. Panel layouts.
 3. I/O configuration and wiring drawings.
 4. PLC programming.
 5. Network configuration.
- B. Installation: CONTRACTOR shall install all the system equipment including PLCs and interconnecting cabling as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
- C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
 1. Equipment size and available space.
 2. Power levels.
 3. Power sources.
 4. Logic schemes.
 5. Signal types and levels.
 6. Interface devices where required.
 7. All other aspects of field devices impacting on the design of the system.

- D. The system shall be programmed to implement the control sequences and to provide the monitoring according to this specification. It shall be the responsibility of System Supplier to include all the inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.
- E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.

1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal wastewater treatment plant.
- B. It is the intent of this specification to define a fully integrated open-type process monitoring and control system, factory-tested, delivered to the site, ready to function upon connection of power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the drawings, specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal wastewater treatment facilities shall provide the specified equipment and services. The system proposed to meet this specification shall be of field-proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and completed system shall conform to applicable portions of the latest edition of the National Electrical Code (NEC).
- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- G. Training Program:
 - 1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.

2. Provide materials, instructors, and workbooks to complete the training.
 3. Training courses shall include:
 - a. Operator training. Course length minimum 4 hours. Training shall utilize equipment specified herein following installation and field testing. One 4-hour sessions shall be provided at the WWTP.
 - b. Maintenance training. Course length minimum 4 hours. One 4-hour sessions shall be provided at the WWTP.
 - c. Training shall not take place until system has been placed in full time operation for minimum 30 days as specified in Paragraph 1.10.C.
 4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
- H. System Supplier shall meet the following minimum requirements:
1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
 2. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
 3. System Supplier shall have an adequate inventory of spare parts.
 4. System Supplier shall have a full-time staff of qualified service technicians.
 5. System Supplier shall be responsible for the programming and documentation of the system.
 6. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
 7. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
 8. System Supplier shall have experience with the specified HMI, on past projects of similar size and complexity.
- I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be Frakes Engineering, (317) 577-3000, Integrated Process Solutions, (608) 849-4375, or Wunderlich-Malec (952) 933-3222, Automated Systems Engineering (513) 826-2287, BSI (513) 201-3100, or Jacobs (513) 595-7500. See General Conditions and Supplementary Conditions regarding substitutions to the Base Bid system suppliers.

1.09 FACTORY ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

- A. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system and demonstrate that the system is operational before shipment from System Supplier factory to the job site. This testing shall be as an integrated assembly by simulating each of the specified I/O points and all specified algorithms.
- B. This test shall be witnessed by OWNER and ENGINEER (two personnel). System Supplier shall provide lodging, meals, and transportation in the Bid for two days and two nights as a minimum for this witness test. Travel cost shall include all rental car fees and refueling fees for each person attending where they driving distance is less than 250 miles. Travel cost shall include all airplane travel fees for any personnel travel that would otherwise require a

driving distance greater than 250 miles. ENGINEER will travel from Madison, WI and OWNER will travel from Sprinboro, OH. All problems, errors, insufficiencies, and failures identified during testing shall be resolved before shipment. In the event the equipment does not operate in accordance with the specifications, programming of controllers/OIPs is incomplete, or setup of equipment is incomplete, there shall be deducted from payments due CONTRACTOR the amount of \$1,500 per day for ENGINEER's time plus travel and expenses \$500 per day, OWNER's travel and expenses as well as all costs for additional, time plus travel and expenses for OWNER and ENGINEER to witness additional factory acceptance testing.

C. On-Site Functional Acceptance Testing:

1. After all equipment has been installed and is placed in full-time operation has been installed and placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
2. All control wiring, hardwired interlocks, OIP screens, control programming, etc., shall be checked out and functionally tested by System Supplier prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
3. CONTRACTOR shall submit updated versions of all OIP screens developed by this System Supplier and OIP screens provided by Divisions 46 to ENGINEER for review at least 1 month prior to the functional acceptance testing of equipment controlled through the associated OIP screens.
4. Coordination Teleconferences:
 - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination teleconference at least two months prior to the anticipated functional acceptance testing. Meeting shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and ENGINEER, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
 - b. CONTRACTOR shall schedule and conduct additional functional acceptance testing coordination teleconferences one month prior to the date for functional acceptance testing to confirm status of equipment installation and System Supplier checkouts, and updates to the functional acceptance testing schedule, after which ENGINEER will finalize reservations for travel and accommodations. All parties shall agree on a date for functional acceptance testing of equipment at this teleconference, or schedule an additional teleconference to establish a testing date one month prior to the delayed testing date. If the functional acceptance testing is rescheduled within one month of the agreed upon date, there will be deducted from payments due to CONTRACTOR the amount of penalties paid by ENGINEER for travel and accommodation cancellations. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
 - c. CONTRACTOR shall provide the following information in written form at each teleconference. All information shall be updated prior to each teleconference.
 - (1) Equipment installation and manufacturer's startup schedule.
 - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.
 - (3) Schedule and status of System Supplier's on-site checkout and functional testing.
 - (4) Anticipated delays and the cause of each delay.
 - (5) Conflicts with OWNER's operation of the facility.

- (6) Proposed dates for acceptance testing of all equipment and controls.
 - (7) Proposed dates for future acceptance testing coordination teleconferences.
 5. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, ENGINEER will make one 3-day trip to check operation. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system and OIP programming, as necessary. If the equipment and controls do not operate according to the Contract Documents, or if CONTRACTOR and System Supplier are not present during the scheduled testing, there will be deducted from payments due to CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses, and for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
 6. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- D. Final acceptance and payment will not be made until the system has operated satisfactorily (without error) for a minimum of 30 consecutive days. CONTRACTOR shall include in Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
 2. Satisfactory operation of software.
 3. Satisfactory operation of control program.
 4. Satisfactory operation of peripheral equipment.
 5. The necessary debugging programs have been performed.
 6. Data output is reliable.
 7. Control loops are operational.
 8. Checking and calibrating of systems have been completed.
- E. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs in the factory and at the site. Field service engineer be present for startup of all systems and available throughout the entire construction process until final completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
 - a. Commissioning, installation, startup, and testing of equipment.
 - b. Revising or rewriting manuals to incorporate an installed and accepted system.
 - c. On-site training.
 - d. Software modifications.
 2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
 - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
 - b. Program modifications.
 - c. Revising or rewriting manuals.
 3. Post-startup support shall include follow-up services during the 1-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 40 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be

used for software enhancements and modifications to improve the operation of the system. In addition to the 40 hours, include one trips to the site.

- F. CONTRACTOR shall not install any hardware or software to enable remote access or control without written permission from OWNER and ENGINEER.

1.10 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel and MCC enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, VFD HIMs, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device. Indicating devices on MCC enclosure doors located in the bottom half of an MCC section shall be mounted as high as possible.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 24 volts and 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, flowmeters and transducers.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 15 ampere, 120-volt receptacle.
- F. If enclosure and panel space is needed for future installation of devices and lights, the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
- G. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- H. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.
- I. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- J. Hardwired control and status signals for motors powered from VFDs and associated equipment, noted in the Section 26 09 90—SCADA System I/O Listing to be communicated to the associated PLC via Ethernet shall be wired to the VFD and communicated to/from the PLC via the SCADA System Ethernet/IP network.

- K. Hardwired Motor Controls:
1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers programmable relays, and communication systems to allow manual operation in the event of an emergency.
 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

1.11 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
1. Run from auxiliary starter contact (dry contact or Ethernet).
 2. Fail from starter overload or VFD auxiliary contact (dry contact or Ethernet).
 3. Start/Stop maintained signal to starter or VFD, or as required (dry contact or Ethernet).
 4. In Auto/In Remote from selector switch on motor controller (dry contact or Ethernet).
 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. Programming algorithms described herein and in Part 3–Execution shall reside within the PLC associated with that equipment.
- C. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate an alarm at the OIP.
- D. All analog and digital inputs shall be monitored in the PLC. This shall include, but not be limited to, flows (water, etc.), electrical values, and levels. The following analog signals shall have minimum, maximum, and running average calculated values: all flows (except aeration air), kilowatts, levels, temperatures, dissolved oxygen, and turbidity. Instantaneous values, totals, maximum, minimum, and average values shall be read by the OIP and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- E. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the OIP and be reset on a daily basis as described below.
- F. Totalized flow values, electrical values (kilowatt-hours), and equipment runtimes as described above shall be stored in the PLC for a period of 7 days. This data shall be available for use by the OIP. The PLC shall indicate the specific date for each of the 7 previous days.
- G. Daily flow totals, runtimes, number of starts, electrical values (kilowatt-hours), and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the PLC through the OIP. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, the PLC shall clear any totals that have accumulated locally.
- H. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, and electrical values (kilowatt-hours). Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.

- I. Indication of time remaining for all timers (hardcoded and operator adjustable) within PLCs shall be made available for indication at the OIP.
- J. Float switches shall include time delays to prevent intermittent starting and stopping and/or alarming because of bouncing floats (including hardwired relay logic).
- K. The operator shall be able to set the processor clock and processor date in the PLC from the OIP. This operation shall be password protected to an Administration level only.
- L. All analog signals shall be scaled to engineering units in the PLC with real or floating-point data types to prevent scaling values in the OIP. System Supplier shall provide all analog ranges and PLC register/tag addresses, to ENGINEER for use with the HMI software. This shall include upper and lower limits for the associated device (i.e., 0 to 150 psi).
- M. For all temperature or level sensing devices, provide a Transducer Fail alarm at the SCADA System for each transducer. Transducer fail shall be defined as the signal from the transducer being out of range.
- N. The following analog signals shall have associated high and low setpoints and alarms: all levels, pH, and dissolved oxygen.
- O. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the OIP. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the Networked PLC. This feature is intended to be used for startup and calibration purposes.
- P. All equipment controlled automatically from the SCADA System shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the OIP. Each associated PLC shall also generate a Call-to-Run Fail alarm if the equipment is called-to-run but does not start within a specific time period. The Call-to-Run Fail alarm shall be generated within the PLC software and may not be combined with other fail signals such as hardwired motor fails, and overtemperature. Call-to-Run Fail alarms shall only be active when in the selector switch on the motor controller is in the "Auto" position.
- Q. In cases where the automatic alternation of equipment is provided by the PLC, indication of the lead, lag, and lag-lag pumps (where applicable) shall be made available for display at the SCADA System.
- R. All controlled equipment as described herein shall have the capability of manual control from the OIP through the manipulation of analog or digital variables. This shall be through the use of a "SCADA H-O-A" switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the OIP.
- S. Where a manual reset is required at the SCADA System (i.e., level lockout, pressure lockout), the OIP shall be configured to set a discrete reset bit. Once the PLC receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.
- T. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for

equipment shall be programmed in the associated PLC. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.

- U. The PLC in SCC-30 shall monitor the scan cycle of the PLC in the mechanical fine screen MFS-10-01 control panel to detect a communication failure. This shall be accomplished by the PLC in SCC-30 setting and resetting a bit internal to its program every 60 seconds. This bit shall then be sent to the PLC in the mechanical fine screen MFS-10-01 control panel. Once this bit is received by the PLC in the mechanical fine screen MFS-10-01 control panel, the PLC shall copy the value of this bit to a second bit internal to its PLC program. This second bit shall be read by the PLC in SCC-30. If the PLC in SCC-30 does not see a change in status of the second bit, a PLC communication fail alarm shall be activated at the SCADA System.
- V. Each alarm shall have a discrete PLC tag that is able to be toggled at the SCADA System OIP to enable or disable the associated alarm from being activated.
- W. The hardwired alarm dialer shall be controlled with a SCADA On-Off-Auto switch and 7-day time clock within the PLC. In SCADA Auto, there shall be an activation time (hour and minute) and deactivation time (hour and minute) for each day. The time clock shall allow activation on one day and deactivation on another. The state of all alarms and dialer channels shall be monitored at the SCADA System.
- X. For SCADA Systems without an HMI computer, the SCADA System shall provide logged data of both alarm and utilization functions for the system.
- Y. In the event of a power failure, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger shall be operator-adjustable from 0 to 300 seconds through the OIP graphics software on the SCADA computers.
- Z. Provide a hardcoded minimum speed within the associated PLC for each pump operating on a VFD. The minimum speed shall be the minimum speed at which the pump will still provide flow. Coordinate minimum speed with the pump manufacturer during start up.

1.12 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 SCADA WIRELESS ACCESS POINT AND TABLET

- A. System Supplier shall include an allowance of \$6,000 in the Lump Sum Base Bid for a hardened tablet, docking station, and a wireless access point. System Supplier shall include in the Lump Sum Base Bid (not part of the allowance) all labor necessary to set up the hardened tablet and wireless access point. Purchase of the hardware shall be held until approved by ENGINEER for review that system is of current technology at project completion. Final selection of system components shall be made at the time of actual

purchase based on latest available technologies. Final cost for this equipment will be adjusted by change order based on actual system costs.

2.02 OPERATOR INTERFACE PANEL (OIP) CONFIGURATION

- A. System Supplier shall include the following as a part of the OIP Configuration:
1. Meetings at initiation, 50% and 90% completion of the OIP graphics with System Supplier's Programmer, OWNER, and ENGINEER to review graphical user interface layouts, alarm configuration, and security information. The graphic displays shall be sent to ENGINEER on USB flash drive with project-specific label at least 1 week prior to each meeting. All meetings will be held via Microsoft Teams videoconference and shall be assumed to be a minimum of 4 hours in duration. Meetings may be attended by any parties associated with the Contract. At a minimum, one representative of System Supplier capable of making binding decisions related to this scope of work shall attend.
 2. An allowance of 40 hours of programming time for software enhancements and modifications to improve operation of the system. This is over and above the programming time required to configure the system to meet these specifications.
- B. The process database shall be configured to access all necessary data from any of the networked PLCs to meet the requirements of the control descriptions in this specification, I/O listings, and descriptions below:
1. The process data shall be collected from the PLC in SCC-30. The system shall be set up so that data is monitored by that PLC.
 2. The process information on the system shall be organized into tags that contain not only the specific process data but also system data such as point description, alarm setpoints, and sampling frequency. The tags shall be available for assignment to or control from the symbols on the graphical user interface screens. The values of the tags shall be used for numerical display, color changes, and so on. The following tag types shall be available for configuration as needed to meet the requirements of the control descriptions and the graphical user interface:
 - a. Analog input: Reading analog values from PLC and scaling to accommodate implied decimal.
 - b. Analog output: Allows writing to PLC registers.
 - c. Digital input: Monitors state changes in PLC registers.
 - d. Digital output: Allows writing state changes to PLC registers.
 - e. Calculated value: Uses input tags to calculate a derived value.
 - f. Trend buffer: Accepts analog inputs to a FIFO buffer for use in displaying real-time trends.
 - g. Timer: Count down or count up to monitor runtimes of all process equipment.
- C. The system shall be configured with security levels to restrict access to portions of the system from individual or groups of operators. Security shall be managed by a central SCADA Server. The system shall have a minimum of four security levels with the following access capabilities:
1. Security Levels:
 - a. Level 1: Users may acknowledge alarms and view all status screens.
 - b. Level 2: Users have all clearance as Level 1 users plus may modify alarm setpoints, modify control setpoints, start- and stop-controlled equipment, assign equipment variables, use the report system, and run additional programs on the machine.
 - c. Level 3: Users have all clearance as Level 2 users plus may stop the program, make changes to screen layout, modify tag database, and make changes to system algorithms.

- d. Level 4: Users shall not have any usage limitations (used for manufacturer or system integrator).
 2. The software shall support a minimum of 100 user names within the various levels of security. Each user shall have a unique login name and password and shall be assigned a security level. Login names, passwords and security levels shall be determined by OWNER. OWNER shall be provided with at least one user account with Level 4 security clearance to allow for future changes in system configuration by others. OWNER shall be able to add/delete users and update passwords from the OIP without downloading the application.
 3. The system shall be designed to log each user out of the system automatically after a predetermined time if there is no activity at the workstation or if the operator requests to log out. Upon an operator logging out, the system shall require another valid user to log into the system before any other task can be completed. The name of the operator who acknowledges alarms, changes system setpoints, or starts/stops controlled equipment shall be logged to the printer with the message for tracking and accountability purposes.
 4. System designer shall restrict access to screens, individual graphical elements, or menu bar selections based on the security level of the user logged into the system.
- D. The OIP shall allow the user to view process information and modify the equipment parameters described in the control descriptions for the various PLCs. Standard Windows graphical elements such as push buttons, radio buttons, check boxes, list boxes, and scalable text shall be used in the configuration of the graphical representation of the processes.
 1. At all times during the viewing of the graphical user interface, the screen shall display a menu bar at the top of each screen. Access to the functions in those areas shall be determined by the security clearance of the operator who is logged into the system. A row of buttons along the side shall allow system navigation to the overview screens, system information screen, historical trend screen, and alarm screen. A four-line alarm summary with the most current alarms shall be displayed at the bottom of all screens at all times. The remainder of the OIP area shall be reserved for the "full-size" screens described below.
 2. The following screens, as a minimum, are required to be configured for the user interface as full-size windows. These screens shall show symbols of all related equipment that are monitored. These symbols shall be labeled and shall be dynamically colored to represent their current states. Instantaneous and totalized flows associated with the process areas shall also be labeled and shown on these screens. Levels shall be labeled and shown and symbols representing fill levels shall be shown:
 - a. WWTP layout with flows (with ability to move to any major process area from this screen).
 - b. Sampling.
 - c. Influent screening system.
 - d. Sludge pumping system (WAS).
 - e. Secondary clarification.
 - f. RAS system.
 - g. Generator control.
 - h. In addition to the drawings listed, the Bid shall include a minimum of 3 additional full-size graphics screens of similar complexity to those listed above.
 3. The OIP described above shall be configured so that control modifications and/or setpoint adjustments may be made by selecting (clicking on) that piece of equipment. This shall bring up a small window that overlays the full-size process screen and contains all control parameters and status indications for the piece of equipment selected. These windows shall be considered separate from the graphic screens

- required above and are required for each piece of controlled equipment and each analog that has associated setpoints for the operator to adjust.
4. All screens listed above shall be configured to allow the operator to open a small window that overlays the full-size process window with a real-time trend chart of the analog signals displayed on the screen versus time. The real-time chart shall be 4 hours in duration and shall display the contents of the trend buffer described above. Each analog variable shall display on the screen in a different color. In addition, the configuration of four additional real-time trend charts with four variables each shall be included in the Bid and shall have variables and time durations determined by OWNER.
 5. Provide real-time trending of historical data over time on individual graphic screens. Analog tags to be trended shall be as selected by OWNER, and a minimum of 10 trend screens shall be included in the Base Bid. Specific layout of each trend screen shall be approved by OWNER, and trend screens shall include two, three or four separate trends per screen. The user shall be allowed to select four fixed chart durations (8-hour, 24-hour, 7-day, and 30-day) for each screen, and each trend shall be able to display a maximum of eight analog tags. Trend screens shall have the capability of zooming in to an operator-specified timespan and, using a real-time legend, shall show time and analog value for pens associated with that trend.
 6. Provide a full-size screen that summarizes system information made available by the software.
- E. Configure the software to provide alarm monitoring for informing the operators of current alarm conditions throughout the system.
1. The alarms that shall be included in the system include the following: All digital inputs to the system that indicate a fail state for a piece of process equipment (e.g., pump fails, power fails); all digital inputs that indicate a level (e.g., HWL); analog inputs that exceed alarm limits within the process database; and system alarms generated by the OIP software (e.g., communication failure).
 2. At the onset of each alarm condition, a log shall be created that indicates the time and date of occurrence, the description of the point in alarm, and the current state or value.
 3. OWNER shall decide which alarms require acknowledgment by an operator prior to being cleared from the system. Those alarms that do not require acknowledgment will be cleared from the alarm system when the state returns to normal condition. Those requiring acknowledgment shall be cleared from the system only after an operator with sufficient security clearance has acknowledged the alarm through the operator interface and the state returns to the normal condition. Whenever an alarm is cleared from the system, a log shall be printed with the time and date of occurrence, description of the point in alarm, the current state or value, and the logged-in operator who acknowledged the alarm (when applicable). Acknowledgment of an alarm shall affect alarm summaries systemwide.
 4. Each process alarm condition shall be capable of being taken out of service by the operator if that operator has security clearance allowing alarm acknowledgment. A log indicating time and date of occurrence, point description, and user name shall be created when an alarm is removed from service.

2.03 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door

switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. All louvers shall be filtered and forced-air cooling shall be provided as necessary for conditions where installed. Provide enclosure dimensions as specified herein. Enclosures shall be as manufactured by Hoffman or Saginaw. MCC structures are not acceptable. Where installed next to motor control centers, enclosure color shall match that of the MCC.

- B. Each PLC enclosure shall include, but not be limited to, the following equipment:
 - 1. PLC, I/O modules, and communication modules.
 - 2. Power supplies.
 - 3. Surge protective devices.
 - 4. DIN-rail mounted terminal blocks for field wiring terminations.
 - 5. Plastic wiring ducts.
 - 6. General purpose 15-amp, 120-volt AC duplex GFCI receptacle.
 - 7. 20-amp, 120-volt AC main circuit breaker and branch circuit breakers as required to feed the PLC and the I/O controlled field devices.
 - 8. Other accessories required to provide a complete and working PLC system.
 - 9. UPS backup for the SCC.
 - 10. Network switch.
 - 11. Front panel-mounted programming port with RJ-45 jack and 120-volt receptacle.
- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
- D. Refer to Section 26 05 53—Electrical Identification for the control panel and field wiring color code.
- E. 24 VDC power supplies shall be provided in the enclosures to power all 24 VDC devices and loop-powered analog input signals, where required. All 24 VDC power shall be fused.
- F. NEMA ratings of enclosures shall be as required for the area where installed, unless specified otherwise.
- G. Manufacturer of Accessories:
 - 1. The plastic wiring duct shall be Panduit Panduct, or equal.
 - 2. Terminal blocks shall meet the requirements of Section 26 05 19—Wire.
 - 3. Wire markers shall meet the requirements of Section 26 05 53—Electrical Identification.
 - 4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
 - 5. Power supplies shall be Sola, DIN rail mount, SPD or SDN Series, or equal.
 - 6. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
- H. All wiring within the enclosure shall be through plastic wiring troughs. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 2 1/2 inches between terminal strip and adjacent wiring trough edge. All wiring labels shall be able to be read without removing wiring trough covers. Wiring troughs shall be provided for all field wiring.

- I. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and record drawings.
- J. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each component, device, and light. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels with white background and black text; minimum size 16 font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- K. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- L. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).

2.04 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS

- A. Construction:
 - 1. A single local chassis shall house a CPU, memory, and communications.
 - 2. A separate power supply shall supply necessary power to each chassis.
 - 3. All system modules shall be DIN rail mounted.
 - 4. All system modules shall be able to operate in an industrial environment with an ambient temperature of 32°F to 140°F.
 - 5. All system modules shall be able to operate in a free airflow environment.
 - 6. All system modules shall have a conformal coating.
 - 7. All system modules shall be able to operate in high electrical noise environments.
- B. The system shall support a minimum of eight local I/O expansion modules in up to three chassis.
 - 1. Local expansion modules shall be installed in the local chassis or in chassis adjacent to the local chassis.
 - 2. The manufacturer shall have available a variety of I/O modules, including, but not limited to, AC or DC discrete input, AC or DC relay contact output, 4-20 mA analog input and output, and RTD.
 - 3. Each chassis in multiple-chassis installations shall be interconnected via Ethernet.
 - 4. Discrete I/O cards shall be 24 VDC 16 point maximum, unless otherwise noted.
 - 5. Isolated discrete I/O cards shall be 8 point maximum. Isolated discrete cards shall be used if there are multiple or external power sources associated with the signals, if wiring leaves the building, or if the card is driving a load (i.e. solenoids, etc.).
 - 6. Analog input cards shall be 8 point.
 - 7. Analog output cards shall be 4 point isolated type.

- C. Central Processing Unit (CPU):
1. The CPU shall be a self-contained unit, and shall be capable of providing control program execution, supporting remote and local programming, controlling all I/O scanning and inter-controller and peripheral communication and diagnostic functions as follows:
 - a. 32 tasks (100 programs per task):
 - (1) Continuous—one allowed.
 - (2) Periodic—Run via an interrupt at a user-defined interval in 1 μ s increments from 1 ms to 2000 s.
 - (3) Event—Triggered by consumed tag or EVENT instruction.
 - b. 256 controller connections.
 - c. Network connections:
 - (1) Up to 256 Ethernet/IP.
 - (2) Up to 120 TCP/IP.
 2. The PLC shall organize user applications as tasks, which can be specified as continuous, periodic, or event based. Tasks shall be triggered by input point or instruction.
 3. The CPU shall have a real-time clock.
 4. When the main power supply is removed, the CPU shall have the ability to back up user program and all data, or a nonenergy storage option.
 5. The front of the CPU shall have a USB port.
 6. The front of the CPU shall have an integrated latching mechanism for securing the secure digital (SD) memory card. The PLC shall operate with the memory card removed.
 7. The processor module shall have LED indicators to indicate CPU status.
 8. The processor module shall have a mode switch.
 9. The process module shall have Version 32 Firmware.
- D. Memory:
1. The PLC shall have a minimum of 3 MB of user memory. Provide additional memory as required.
 2. The program storage medium shall be solid-state, nonvolatile type.
 3. The PLC shall include a 1 GB SD memory card to store the user program and the firmware of all modules residing in the same chassis to protect against memory loss.
- E. Programming Environment:
1. Programming shall be through the USB 2.0 port or through the Ethernet/IP network.
 2. The programming software shall run on the latest version of Windows and the programming methods shall be:
 - a. IEC 61131-3 compliant ladder diagram.
 - b. Structured text.
 - c. Function block diagram.
 - d. Sequential function chart.
- F. Communication:
1. USB 2.0 port to support upload and download, online edits, firmware updates, and bridging to other modules.
 2. Ethernet/IP switch and dual 10/100/1,000 Mbps Ethernet/IP ports with 1 IP address. The interface shall support:
 - a. IEEE 802.3 Physical and Data Link Standard.
 - b. Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging.
 - c. Standard TCP/IP and UDP/IP communication.
 - d. 10/100/1,000 Mbps auto sensing and auto switching.

- e. Standard Ethernet media.
 - f. Subnet masking.
 - g. BOOTP and DHCP support.
 - h. Manual configuration using specified software.
 - i. Programmable Logic Controller messaging to peer controllers and workstations.
 - j. I/O data, real-time interlocking and information.
 - k. Full or half-duplex communication.
 - l. Built-in web access to diagnostics.
 - m. I/O control.
 - n. Precision Time Protocol (CIP Sync, IEEE 1588).
- G. Power Supply:
- 1. The power supply shall operate on 24 VDC, single-phase.
 - 2. A single, main power supply shall be capable of supplying all necessary power to the local chassis housing the CPU and local I/O modules. Provide a dedicated power supply for each chassis.
 - 3. The power supply shall be capable of converting AC power to the DC power required to operate the PLC system.
 - 4. The power supply shall include an easily viewed indicator to show status of the DC power applied to the backplane.
 - 5. The power supply shall provide electronic protection:
 - a. At the time of power-up, the power supply shall inhibit operation of the controller and I/O modules until the DC voltages are within specifications.
 - b. The power supply shall automatically shut down the PLC when its output power exceeds 125% of its rated power.
 - c. The power supply shall provide surge protection, isolation and outage carry-over of up to 6 cycles of the AC line or 40 ms at 24 VDC.
 - d. The power supply shall be fused.
- H. PLCs shall be as manufactured by Rockwell Automation, CompactLogix 5380 L3 Series, or equal.
- I. PLC Programming and PLC Software: System Supplier shall provide all PLC programming and software required to meet this specification. The software shall include, but not be limited to, the following:
- 1. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified herein. The System Supplier shall document and annotate the programs, update them as required after startup, and then turn two copies of the programs over to OWNER on two USB flash drives with project-specific labels.
 - 2. System Supplier shall provide a commercially available PLC programming and documentation software package as developed by the system manufacturer for documenting and modifying the PLC programs.
 - 3. All I/O addressing that is to be viewed or manipulated by the HMI software shall be organized into contiguous blocks of integer tags for discrete bits and floating point tags for all other values to facilitate block data transfer between computers and PLCs.

2.05 UNINTERRUPTIBLE POWER SUPPLIES

- A. Provide a UPS backup in each SCC that will provide continuous communication for at least 30 minutes following a power failure.
- 1. UPS power shall be provided, at a minimum, to the following equipment:
 - a. PLCs and I/O cards, controllers, and OIPs.

- b. Network switches, signal converters, and other communication devices.
 - c. Power fail and communication indicating lights and alarm devices.
 - d. Power supplies for loop-powered instruments.
 - e. Automatic alarm dialers.
 - f. Intrinsic safety barriers.
2. Each UPS shall be plug connected inside the control panel with a dedicated receptacle and overcurrent protection device. All UPS-powered devices shall be continuously powered through the UPS under normal operating conditions. Provide UPS voltage monitoring relays to automatically bypass the UPS when the UPS output rises 110% above or falls below 90% of the nominal supply voltage.
 3. Provide a stand or shelf within the control panel for the UPS and batteries so that they do not sit on the bottom of the enclosure.
- B. Interior control panels with PLCs shall be provided with a true online 120-volt AC UPS.
1. Each UPS shall be provided with a dry contact output for remote indication of a common UPS alarm or if UPS batteries need replacement.
 2. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.

2.06 INDUSTRIAL CONTROL RELAYS AND CONTACTORS

- A. Industrial control and power relays shall be installed in motor control centers and motor starter enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for monitoring the output voltage of uninterruptable power supplies shall be UPS voltage monitoring relays.
- B. Relays shall meet the following requirements:
1. Interposing/isolation relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 24 VDC, or as required by System Supplier.
 - d. Contact rating: 8 A (DPDT), 16 A (SPDT).
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
 2. General purpose relays:
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 24 VDC.
 - d. Contact rating: 15 A, minimum; 3/4 hp.
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 3. UPS voltage monitoring relays:
 - a. Configuration: SPDT.
 - b. Mounting: DIN rail.
 - c. Voltage: 24 VDC.
 - d. Contact rating: 15 A.
 - e. Operating life: 10 million cycles.
 - f. Over-voltage range: 80 to 150 VAC, adjustable.

- g. Under-voltage range: 30 to 95% of pickup, adjustable.
 - h. Drop-out time delay: 0.1 to 10 seconds, adjustable.
 - i. UL listed.
 - j. Manufacturer: Macromatic, VWKE120A, or equal.
4. Power contactors:
- a. Configuration: Electrically-held, 3 poles.
 - b. Mounting: DIN rail.
 - c. Voltage: 24 VDC.
 - d. Minimum contact rating: 20 A continuous, 1 hp.
 - e. Operating life: 1.3 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.
5. Duplex alternation relays:
- a. Configuration: DPDT or DPDT cross wired.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 24 VDC.
 - d. Contact Rating: 10 A, minimum; 1/8 hp.
 - e. Operating Life: 10 million mechanical operations and 100,000 electrical operations.
 - f. Status: Output position indicating LEDs.
 - g. Control: Three-position toggle switch permitting selection of normal duplexing action, locking in the A-B sequence, or locking in the B-A sequence. Alternation shall be able to be toggled every time a 24VDC control signal is removed.
 - h. Manufacturer: Diversified Electronics, ARA, or equal.

2.07 LUMINESCENT DISSOLVED OXYGEN (DO) MONITORING SYSTEM

- A. The controller shall accept one or two inputs from Hach digital sensors utilizing MODBUS protocol and shall be multiparameter, accepting inputs from any Hach digital sensor.
- B. The controller shall have a graphical dot matrix LCD display with 160 x 240 pixels and LED backlighting. The main display readout height shall be 1/2-inch. Auxiliary information readout height shall be 1/8-inch. Menu screens shall contain up to six full lines of conversational text.
- C. The display shall be able to simultaneously display a single reading, dual reading or a calculated value. Simultaneously displayed auxiliary information shall include analog output values, process temperature, the date and time, relay status, diagnostic warnings, or error messages.
- D. The analyzer shall have six calibration methods: (1) "In the Process" Probe method for input of DO value obtained from a calibrated portable DO meter; (2) "In the Process" Sample method for input of sample DO value derived by lab analysis using Winkler Method; (3) "In the Process" Saturated method for use when process is known to be 100% saturated with air (analyzer computes ppm value for calibration); (4) "In Water" Probe; (5) "In Water" Sample; and (6) "In Water" Saturated methods.
- E. The analyzer shall have high alarm, high alarm deadband, low alarm, low alarm deadband, off delay and on delay, and fail low software alarm settings for measured DO and temperature.
- F. The analyzer shall have two sets of isolated analog outputs. Each set shall consist of 0 to 5 VDC/0-1 mA and 4-20 mA. Each output shall be able to be assigned to represent the measured DO or temperature. The user shall be able to assign minimum and maximum DO

values or temperature values that produce the respective minimum and maximum output values. Each output set shall be selectable to track the measurement, hold present output values, or transfer outputs to predetermined values. The display shall indicate an error message for each 4-20 mA output loop that is open.

- G. The analyzer enclosure shall be NEMA 4X with a polycarbonate face panel and epoxy-coated cast aluminum door and case.
- H. Analyzers shall be installed in fiberglass, hinged-cover, NEMA 4X enclosures with window and front door-mounted, rotating handle, Hoffman Model Ultrx, or equal. Enclosures with side clamps or hasps are not allowed. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, anti-condensation heater, Hoffman DAH Series, or equal, with temperature control switch model ATEM. Mount the analyzer off the enclosure back panel so the display is visible at the enclosure window. Provide sun shields for all analyzers.
- I. The analyzer shall be Hach, Model SC200, with 115-volt power supply, single fuse, and FM-approved.
- J. The probe body shall be made up of foamed Noryl and 316 stainless steel with polybutyl methacrylate material sensor. Dissolved oxygen readings shall be performed using luminescent technology consisting of a blue LED, red LED, and photo diode.
- K. The LEDs shall be enclosed by a chamber with sensor cap to protect them from direct contact with air bubbles and material suspended in wastewater. Sensor cap shall be screw-on type with field replaceable design.
- L. The sensors shall automatically compensate for changes in the process temperature. The probe shall be factory-calibrated with the option to calibrate manually using a laboratory sample or air calibration.
- M. The sensors shall have an integral 30-foot cable terminated with a quick-disconnect plug and junction box.
- N. The sensor's accuracy shall be ± 0.1 ppm (mg/L) below 5 ppm or ± 0.2 ppm (mg/L) above 5 ppm.
- O. The sensors shall be threaded on the cable end to mate with mounting hardware. Sensors shall be mounted as directed by the manufacturer using pole-mount kit, Model 9253000. Pole-mount kit shall be provided for each sensor.
- P. The probes shall be Hach, Model 9020000. Probe shall include 3-year warranty; sensor cap shall include 2-year warranty. Provide 3-year supply of sensor caps, to be shipped at future dates from original installation.
- Q. Provide one day of startup service by a factory-trained technician. CONTRACTOR shall schedule date and time for the official startup. Provide startup report to OWNER and ENGINEER after completion.

2.08 PH ANALYZER SYSTEM

- A. The sensor shall be wired to the analyzer specified under 2.06 Luminescent Dissolved Oxygen (DO) Monitoring System.

- B. The sensor shall have a measurement range of -2 to 14 pH with a sensitivity of ± 0.01 pH. Stability of the sensor shall be 0.03 pH per 24 hours, noncumulative.
- C. The convertible mounting shall be used for submerged service. Sensor shall be a 5-wire sensor with integral preamplifier and shall have a hex-shaped body to facilitate mounting.
- D. The sensor shall be constructed of liquid crystal polymer (PEEK) for exceptional mechanical strength and resistance from chemical attack.
- E. The sensor shall be made leakproof by casting its body so that its components are completely encapsulated.
- F. The sensor signal shall be automatically temperature compensated by an integral temperature sensor. The sensor shall not polarize when removed from the process while energized.
- G. The sensor shall include a titanium ground electrode to cause ground loop currents to bypass the measurement system without causing disturbance. The electrode material shall be glass.
- H. The sensor shall include close-coupled electronics for low impedance, capable of transmitting 1,000 feet without additional preamp. Provide sensor cable length as required.
- I. Sensors shall be Hach Model PHD, or equal.
- J. Submerged service sensors shall be provided with submersion mounting hardware to include a PVC pipe (length as required by the manufacturer for recommended submergence) and coupling with PVC pipe-mount junction box and protector.

2.09 FLOAT SWITCHES

- A. Float switches when specified herein, shown on the Drawings, or necessary to complete an operating system shall be as follows:
 - 1. The float switches shall be mercury free and consist of a 304 stainless steel housing 5 1/2-inch diameter, stainless steel mounting clamp, a flexible two-conductor cable with a CPE jacket, and a potted SPST magnetic reed switch. Provide switch configuration (NO or NC) as required. The electrical load for the switch contacts shall be 100 VA at up to 250 volts. Float switches shall include a two-conductor cable 16 AWG with fine strands made for heavy flexing service and underwater use. Provide cable length as required for a continuous run to the terminating control panel. Provide a minimum 10 feet of slack in all cables in wet wells and tanks. A green grounding wire shall connect internally to the float housing. Floats shall be Siemens Model 9G-EF, Anchor Scientific Model SSTNM, or equal.
 - 2. Weight and buoyancy shall be such that contaminants will not result in the float switch changing operating level more than 1-inch.
 - 3. Operating temperature range shall be -31°F to 110°F .
- B. Floats shall be mounted on a stainless steel cable with PVC-covered anchor according to manufacturer's instructions. All mounting hardware shall be stainless steel and provided with the floats.
- C. Provide stainless steel kellum grips for each float cable.

- D. All floats indicated on the Drawings or specified herein to be intrinsically safe in design shall be as such. Provide intrinsically safe barriers as specified herein.

2.10 OPEN CHANNEL FLOW TRANSMITTERS

- A. Open channel flow transmitters shall utilize an ultrasonic, noncontracting method to measure flow through the V-Notch Weir with an accuracy of $\pm 0.25\%$ of measurement. Flow calculation shall be selectable from a "standard" exponent for the given open channel type, but it shall allow field entry of user-selected exponents. A 4-digit local display shall allow operator-selected display of flow rate, level, and 8-digit totalized flow. Flow rate shall be field-programmed for units of flow, gpm, mgd, etc. All adjustments shall be by digital values in EEPROM, providing memory storage through power failures without requiring battery backup. Totalized flow shall be stored to EEPROM to minimize lost data during a power outage. Field adjustments shall include zero, span, blanking, dampening, low flow totalization suppression, and sampler or totalizer pulse output. Programming shall be performed by a removable, portable keypad module maintaining NEMA 4 enclosure integrity during programming or when removed from the enclosure. Output shall be isolated 4-20 mA dc into a 750-ohm load and a pulse output proportional to totalized flow.
- B. Transducers in non-rated locations shall be FM approved and have an operating range of -40°F to 200°F.
- C. The transducer radiating surface shall be self-cleaning and shall operate without problems in moisture, dust, and frost. It shall be suited for continuous submergence, with the interconnecting cable splice made above flood level. The transducer shall be designed to amplify acoustic output 54 times over normal outputs. Transducer beam angle shall be 6 degrees. CONTRACTOR shall coordinate transducer mounting height with maximum water level to be monitored.
- D. The interconnecting cable between transducer and the transmitter shall be provided with the instrument, limited to 1,200 feet, and be run in a conduit separate from other wires or cables. The transducers shall be temperature compensated through an integral temperature sensor. Provide a 120-volt AC power source for the transmitter.
- E. For all transmitters located outdoors, the transmitter shall be installed in a fiberglass, hinged-cover, NEMA 4X enclosure with window and front door-mounted, rotating handle, Hoffman Model Ultrx, or equal. Enclosures with side clamps or hasps are not allowed. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, anti-condensation heater, Hoffman DAH Series, or equal, with temperature control switch model ATEM. Mount the transmitter off the enclosure back panel so the display is visible at the enclosure window. Provide sun shield for all transmitters located outdoors.
- F. The open channel flow transmitter shall be Siemens Hydro Ranger, or equal. The open channel flow transducer shall be Siemens EchoMax XPS-15 series, or equal.

2.11 MAGNETIC FLOW METERS

- A. The magnetic flow meters shall be suitable for measuring sludge flows in the range indicated in the table below. The magnetic flow meters shall consist of a flanged sensor with grounding rings and remote electronics. The tube shall be of 304 stainless steel with hard rubber liner. Flanges shall be carbon steel and conform to ANSI B16.5, Class 150. The meter shall be NEMA 4X construction.

- B. The meters shall utilize bipolar DC coil excitation or other means to automatically rezero. Meters shall be provided with grounding rings made of material compatible with electrode material. Electrodes shall be bullet nose, 316 stainless steel suitable for sludge applications with up to 10% solids.
- C. Power consumption shall not exceed 20 watts. The meter shall incorporate design features to minimize the effect of greasy (nonconductive) coatings or incorporate a means to automatically clean the electrodes during continuous operation. Meter accuracy shall not be affected by greasy coatings, and cleaning of the meter manually shall not be required.
- D. Meter accuracy shall be $\pm 0.5\%$ of rate from 1.0 to 30.0 ft/sec and 0.1% of scale below 1.0 ft/sec when installed with the appropriate upstream and downstream pipe diameters. The meters shall be wet-calibrated in a primary flow laboratory traceable to the National Institute of Standards and Technology. Transmitters and flow tubes shall be interchangeable.
- E. The meter shall be designed to operate on 120 VAC, 60 Hz. Connections at the flow tube shall be factory-potted to provide NEMA 4 as installed ratings. Outputs shall be 4-20 mA into 800 ohms maximum and 24 VDC scaled pulse, 0 to 2 Hz maximum, 150 ohms minimum, suitable for driving a solid-state counter. Pulse width and volume of flow per pulse shall be widely adjustable before or after installation to allow interface with PLC input cards and other devices.
- F. Outputs shall be field-adjustable for range changes. Response time or damping shall be adjustable from 0.8 to 8.0 seconds. The meters shall be operable in all liquids with 5.0 umhos/cm or more conductivity.
- G. The meters shall include empty pipe detection and shall meet the requirements of IP68 rated for submergence. Magnetic flow meter tubes shall be rated for a Class I, Division 2, Groups C and D location. Meters shall be capable of reading forward and reverse flow with dedicated analog outputs and totalizers.
- H. The magnetic flow meters shall be Siemens 5100W. Meters shall be sized to match the nominal pipe diameter in which they are installed. Provide cable, length as required, to reach the remote-mounted signal converter; CONTRACTOR shall coordinate. Flow meter shall be:

Tag No.	Size (Inches)	Maximum Scale
FIT-50-01	4	300 GPM

- I. Provide each flow meter with a remote signal converter. Signal converter shall be FM approved and CSA certified. Remote and integral electronics shall include back-lit display and push buttons or other means for local operation and maintenance. Display shall include instantaneous flow totalizer and indication of present faults.
- J. For all remote transmitters located outdoors, the transmitter shall be installed in a fiberglass, hinged-cover, NEMA 4X enclosure with window and front door-mounted, rotating handle, Hoffman Model Ultrx, or equal. Enclosures with side clamps or hasps are not allowed. Enclosure shall include a main circuit breaker disconnect, surge protection devices specified herein, anti-condensation heater, Hoffman DAH Series, or equal, with temperature control switch model ATEM. Mount the transmitter off the enclosure back panel so the display is visible at the enclosure window. Provide sun shield for all transmitters located outdoors.

2.12 SUBMERSIBLE LEVEL TRANSMITTERS

- A. Where indicated on the Drawings, levels shall be sensed by a submersible pressure transmitter. The transmitter shall be a KPSI Model 750, or equal loop powered submersible pressure transmitter, with an intrinsically safe wiring barrier. The transmitter shall be of the head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 6 inches above the floor. The sensor shall be mounted using a self-supporting cable system; location shall be determined in the field. Cable shall be vented, reinforced, and rated for full weight of transmitter. A separate support cable or anchor shall not be required. Provide stainless steel Kellum grip at suspension point, Hubbell, or equal.
- B. The transducer shall sense water level (pressure) variations and transform these variations directly into a standard process signal of 4-20 mA over the desired level range (span). The transducer shall be completely solid-state, with no mechanical linkages or moving parts. Supply voltage shall be as required by CONTRACTOR. Accuracy shall be $\pm 0.25\%$ of full scale. Transmitter shall be backed by a minimum 2-year warranty.
- C. The transducer shall incorporate a variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against a Teflon coated Buna-N or elastomeric diaphragm that flexes minutely so as to vary its proximity to a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensation and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range. Operating pressure range of the transducer shall be approximately 0 to 15 psig.
- D. Provide lightning protection integral to the transmitter and at the cable termination with lifetime warranty against damage caused by lightning.

2.13 OPERATOR INTERFACE PANEL

- A. The operator interface shall meet the following general specifications:
 - 1. Voltage: 24VDC.
 - 2. Temperature: 0° to 55°C.
 - 3. Humidity: 5% to 95% noncondensing.
 - 4. RFI: MIL-STD-461B.
 - 5. EMI: IEEE 472-1974.
 - 6. Communication Port: Ethernet.
- B. The operator interface shall have the following minimum features:
 - 1. Type: Color Active Matrix Thin Film Transistor (TFT) touchscreen LCD.
 - 2. Display Size: 15-inch.
 - 3. Resolution: 1024 by 768, 18-bit color graphics.
 - 4. Clock: Battery-backed real time.
 - 5. Application Memory: 512 MB.
 - 6. Enclosure: NEMA Type 12.
- C. The operator interface panel shall be as manufactured by Allen-Bradley, Panelview Plus 7 Performance, or equal. Provide Factory Talk View Studio for Machine Edition programming software.

2.14 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS, INSTRUMENTATION, AND NETWORK EQUIPMENT

- A. The incoming power supply of each supervisory control center shall be protected with a surge protective device (SPD). SPD unit shall be as manufactured by Citel Model DS240, or equal. Surge protection shall be provided for all phases and neutral.
- B. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail mounted surge protection device as manufactured by Citel Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel Model TSP15M, or equal, on the output and Citel Model DS240, or equal, on the power supply. Surge protection shall be provided for all phases and neutral.
- C. Each Ethernet cable entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail-mounted surge protection device rated up to 10 Gbps as manufactured by Phoenix Contact, model DT-LAN-CAT6+, or equal.

2.15 INTRINSIC SAFETY BARRIERS

- A. Instrumentation equipment located in hazardous areas as noted on the Drawings shall be wired to intrinsic safety barriers. Safety barriers for discrete devices shall include indicating LED and be DIN-rail mounted, as manufactured by Phoenix Contact, Model MACX MCR-EX-SL-2NAM, (voltage as required), PR Electronics, Model 5202B2, or equal. Safety barriers for analog devices shall be DIN-rail mounted, as manufactured by Phoenix, Model MACX MCR-EX-SL-RPSSI, PR Electronics, Model 5104B, or equal.

2.16 INDUSTRIAL ETHERNET SWITCHES

- A. Managed Switches–Gigabit Uplink:
 - 1. Provide managed Ethernet network switches with Gigabit-Uplink SFP ports where shown on the Drawings. Network switches shall be as manufactured by Allen-Bradley Stratix 5700 Series. Each switch shall include, but not be limited to, the following:
 - a. Selectable Gigabit Ethernet star or ring topology with redundant fail-over. Switches shall be configured for a ring topology, unless noted otherwise.
 - b. DIN rail mounting and redundant 24-volt DC power supply inputs. Provide redundant power supplies, Hirschmann Model RPS series, or equal.
 - c. Command line interface, DHCP, and store and forward switching.
 - d. SNTP real time clock.
 - e. IP and MAC port security and SNMPv3.
 - f. Compliance with the following IEEE Standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x flow control, 802.1w RSTP, and 802.1Q VLAN.
 - g. SNMP with web browsing for switch configuration, diagnostics, and monitoring.
 - h. Dry contact alarm output for indication that the switch has failed.
 - i. Up to two combo SFP, Gigabit Ethernet uplink ports and up to 16 copper 10/100 Fast Ethernet ports. The switch shall have a minimum of 25% spare ports.
 - 2. Switches shall be in compliance with IEEE Standards 802.3af PoE and 802.3at PoE+ and shall support minimum 90 watts of PoE loading. Provide additional switches for installations where one switch will not provide adequate PoE port quantities or total power demand.

2.17 TURBIDITY MONITORING PANEL

- A. Provide surge protective device and sun shield for all transmitters.
- B. The monitoring enclosure shall include a main circuit breaker and surge protective devices as specified herein. The enclosure shall be factory pre-wired to accept a 120-volt, 20-amp, 60-Hz incoming power feed and distribute power to the turbidity controller and sample water pump specified below.
- C. The monitoring panel shall include the following equipment:
 - 1. Hach SC200 controller, no equal. Controller shall provide a 4-20 mA turbidity output signal to the plant SCADA System. Mount the analyzer off of the enclosure backpanel so the display is visible at the enclosure window.
 - 2. Hach TU5300 turbidimeter with bubble trap, no equal. Turbidimeter shall be powered from the factory-installed sensor cable connected to the SC200 controller.
 - 3. Holding rack for the turbidity head during servicing.
 - 4. Turbidity flow diverter assembly to supply sample water to the turbidimeter and divert excess flow to a drain pipe. The flow diverter's 3/4-inch supply water and 3/4-inch drain water piping shall be connected to couplings installed through the bottom of the panel for connection to Division 40-provided supply and drain water piping.
 - 5. Dedicated 3/4-inch drain pipe for the turbidimeter sample water outlet connected to a coupling installed through the bottom of the panel for connection to Division 40-provided drain piping.
 - 6. 120-volt, 60 Hz, in-line, sample-water pump. Enclosure shall be factory pre-wired and pre-piped for connections to the field installed pump and piping in line with the internal flow diverter. Pump shall be sized as required to maintain minimum 250 ml/min of supply water flow to the turbidimeter, maximum 1/6 horsepower.
- D. All electrical conduit and equipment installed inside the control panel shall be NEMA 4X or be installed in a NEMA 4X sub-enclosure and be capable of operating continuously if sprayed with water during a piping failure event.

PART 3-EXECUTION

3.01 MOTOR CONTROL CENTER 30 (MCC-30) NOTES

- A. Aeration Tank Blowers (B-20-01, B-20-02, and B-20-03):
 - 1. L-O-R Selector Switch:
 - a. With the L-O-R selector switch in the "Local" position, the motor shall start and run continuously at the speed set on the VFD HIM.
 - b. With the L-O-R selector switch in the "Off" position, the motor shall be inoperable
 - c. With the L-O-R selector switch in the "Remote" position, the motor shall be controlled from the SCADA System as described under SCC-30.
 - 2. Provide an extra capacity control power transformer for 120-volt power to the associated 500-watt blower enclosure heater.
 - 3. The motor has internal thermostats that shall shut down the motor in the event of over-temperature ("Local" and "Remote" modes). Manual reset shall be required to restart the motor. The thermostats shall be wired such that momentary power interruptions do not shut down the motor.
 - 4. There is a high discharge air temperature switch (TSH-20-01, TSH-20-02 and TSH-20-03) provided as specified in Division 43 that shall shut down the motor in the

- event of a high discharge air temperature condition (“Local” and “Remote” modes). Manual reset shall be required to restart the motor.
5. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the “Off” position.
 6. All of the above controls shall be hardwired and not through the PLC.
- B. Sludge Holding Tank Blower (B-70-01):
1. L-O-R Selector Switch (at unit):
 - a. With the L-O-R selector switch in the “Local” position, the motor shall start and run continuously.
 - b. With the L-O-R selector switch in the “Off” position, the motor shall be inoperable
 - c. With the L-O-R selector switch in the “Remote” position, the motor shall be controlled from the SCADA System as described under SCC-30.
 2. Provide an extra capacity control power transformer for 120-volt power to the associated 500-watt blower enclosure heater.
 3. The motor has internal thermostats that shall shut down the motor in the event of over-temperature (“Local” and “Remote” modes). Manual reset shall be required to restart the motor. The thermostats shall be wired such that momentary power interruptions do not shut down the motor.
 4. There is a high discharge air temperature switch (TSH-70-01) provided as specified in Division 43 that shall shut down the motor in the event of a high discharge air temperature condition (“Local” and “Remote” modes). Manual reset shall be required to restart the motor.
 5. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the “Off” position.
 6. All of the above controls shall be hardwired and not through the PLC.
- C. Secondary Clarifiers (SCD-40-01 and SCD-40-02):
1. O-O Selector Switch (at unit):
 - a. With the O-O selector switch in the “On” position, the motor shall start and run continuously.
 - b. With the O-O selector switch in the “Off” position, the motor shall be inoperable.
 2. There are two torque switches at each unit (WSH-40-01 & WSHH-40-01 for SCD-40-01 and WSH-40-02 & WSHH-40-02 for SCD-40-02), one set for alarm and the second for shut down as well as alarm. The shutdown torque switch shall be wired to the motor starter to shut down upon the unit activation of this switch. Manual reset shall be required to restart the motor. The shutdown torque switch shall be wired such that momentary power interruptions do not shut down the motor.
 3. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the “Off” position.
 4. All of the above controls shall be hardwired and not through the PLC.
- D. RAS/WAS Pumps (RASP-50-01 and RASP-50-02):
1. L-O-R Selector Switch:
 - a. With the L-O-R selector switch in the “Local” position, the motor shall be controlled from the associated start and stop pushbuttons located at the unit.
 - b. With the L-O-R selector switch in the “Off” position, the motor shall be inoperable.
 - c. With the L-O-R selector switch in the “Remote” position, the motor shall be controlled from the SCADA System as described under SCC-30.
 2. The motor has internal thermal overloads which shall shut down the motor in the event of over-temperature (“Local” and “Remote” modes). Manual reset shall be required to restart the motor. Internal thermal overloads shall be wired such that momentary power interruptions do not shut down the motor. The motor also has internal moisture detection

that shall be for indication at the MCC and SCADA. This shall not shut down the motor. There is a 120-volt AC pump protection relay furnished with the unit as specified in Division 43 for thermal and moisture detection that shall be installed in the MCC VFD bucket by CONTRACTOR.

3. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
4. All of the above controls shall be hardwired and not through the PLC.

E. Plant Drain Pumps (P-80-01 and P-80-02):

1. L-O-R Selector Switch (at unit):
 - a. With the L-O-R selector switch in the "Local" position, the motor shall start and run continuously.
 - b. With the L-O-R selector switch in the "Off" position, the motor shall be inoperable
 - c. With the L-O-R selector switch in the "Remote" position, the motor shall be controlled from the SCADA System and the hardwired backup float controls as described under SCC-30.
2. The motor has internal thermal overloads which shall shut down the motor in the event of over-temperature ("Local" and "Remote" modes). Manual reset shall be required to restart the motor. Internal thermal overloads shall be wired such that momentary power interruptions do not shut down the motor. The motor also has internal moisture detection that shall be for indication at the MCC and SCADA System. This shall not shut down the motor. There is a 120-volt AC pump protection relay furnished with the unit as specified in Division 43 for thermal and moisture detection that shall be installed in the MCC starter bucket by CONTRACTOR.
3. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
4. All of the above controls shall be hardwired and not through the PLC.

F. Post Aeration Blower (B-60-01):

1. O-O Selector Switch (at unit):
 - a. With the O-O selector switch in the "Off" position, the motor shall be inoperable.
 - b. With the O-O selector switch in the "On" position, the motor shall start and run continuously.
2. Provide an extra capacity control power transformer for 120-volt power to the associated 500-watt blower enclosure heater.
3. The motor has internal thermostats that shall shut down the motor in the event of over-temperature. Manual reset shall be required to restart the motor. The thermostats shall be wired such that momentary power interruptions do not shut down the motor.
4. There is a high discharge air temperature switch (TSH-60-01) provided as specified in Division 43 that shall shut down the motor in the event of a high discharge air temperature condition. Manual reset shall be required to restart the blower.
5. The motor disconnect has an auxiliary contact that shall be wired to the MCC such that control power is disconnected when the disconnect is in the "Off" position.
6. All of the above controls shall be hardwired and not through the PLC.

3.02 SUPERVISORY CONTROL CENTER GENERAL

- A. Control descriptions described herein are specific in nature to equipment associated with each SCC. CONTRACTOR shall refer to Section 1.11-General Control Algorithms for additional programming requirements.
- B. UPSs installed in all SCCs shall be configured to provide a dry contact output to the PLC in the event of a UPS common alarm. The common alarm shall include, but not be limited to,

“UPS Fault” and “Replace Battery” alarms. Indication of a “UPS Common Alarm” shall be provided at the SCADA System for each UPS.

- C. Each SCC shall have an exterior, panel-mounted receptacle and programming port for the Ethernet network mounted to the front of the panel. The receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door.
- D. Provide a control power fail relay in each SCC that shall be used to indicate an incoming control power fail alarm at the SCADA System. Provide a red indicating light on the front of the SCC to indicate a loss of incoming line power to the SCC. Control power fail wiring shall be hardwired and not through the PLC.
- E. There is a configurable network switch fail contact available at each managed network switch. This fail contact shall be wired to a relay, which shall be wired to the associated PLC for indication of a common network switch alarm. Each network switch shall be configured by System Supplier (via software) to provide this alarm.
- F. Refer to the Section 26 09 90–SCADA System I/O Listing for all required I/O that shall interface with each PLC. For each PLC, provide the lesser of either a minimum of 25% spares or one completely spare I/O module for analog and discrete inputs and outputs. All spare and unused I/O shall be wired to terminal blocks.

3.03 SUPERVISORY CONTROL CENTER SCC-30

- A. Provide a new NEMA 12, freestanding PLC-based supervisory control center, sized a minimum of 24 inches and maximum of 36 inches wide by 20 inches deep by 90 inches high, where shown on the Drawings. All control algorithms and alarms described herein shall be programmed into this PLC.
- B. Provide a 120-volt to 24VDC power supply sized as required for 24VDC control power. All power within the SCC shall be 24VDC except for the incoming 120-volt input to the power supply.
- C. The OIP shall be programmed to allow the operator to enter all control and alarm setpoints associated with the SCC. The OIP shall be set up such that it prompts the operator for the setpoints to be entered. The OIP shall provide indication and operating functions for the system as follows:
 - 1. A process overview and zoomed-view screens as required for additional details for all processes that are monitored and/or controlled from this PLC.
 - 2. System status.
 - 3. Control switches (e.g. Hand-Off-Auto, On-Off, Open-Close-Auto, etc.) and pushbuttons for each piece of equipment.
 - 4. Adjustment for all system setpoints.
 - 5. Running, failed, open, closed, required, etc. for each piece of equipment.
 - 6. Status of all equipment and equipment run times.
 - 7. Indication of all analog signals.
 - 8. Control system timers and indication of time remaining and time to start for each timed sequence.
 - 9. Indication of all alarm conditions on an alarm summary screen. This screen shall show the last 10 alarms, indicate whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge all or individual alarms from this screen. When an alarm is received, the OIP shall default to this screen to show the

current alarm. The current alarm shall blink until acknowledged. Alarms shall list the time and date of each occurrence and be listed in chronological order.

10. Include in the bid, the creation of an additional five HMI screens of similar complexity to those specified herein for the OIP.
- D. The OIP graphics configuration shall follow a situational-awareness theme that avoids the excessive use of color for process screen backgrounds, menus, borders, headers, buttons, equipment symbols, and text displays. Equipment symbols shall adhere to a specific color code for indication of equipment status and alarms. Avoid non-animating colors on equipment graphics. Main process graphic and popups screens shall use a light gray background color. Simulated facility graphics, environments, and three-dimensional layouts shall not be included on the backgrounds. Piping shall be represented by thin, solid-gray lines and shall not include contour shading. Process structures and tanks shall be represented using simple shapes (e.g., squares, rectangles, circles, etc.) and process equipment should be represented by simple, equipment-specific shapes (i.e., no gradients or shading).
1. Equipment:
 - a. Light gray shall be used to indicate that the equipment is not operating or running and has been disabled from automatic operation.
 - b. Yellow shall be used to indicate that the equipment is not running or operating, but is in an automatic control state and ready to operate once the operating conditions are met.
 - c. Orange shall be used to indicate that the equipment is called to run, but is not yet running.
 - d. Green shall be used to indicate that the equipment is running or operating in the forward direction.
 - e. Blue shall be used to indicate that the equipment is running or operating in the reverse direction.
 - f. Red shall be used to indicate failure conditions for equipment and signals.
 2. Valves:
 - a. Light gray shall be used to indicate that the valve is closed.
 - b. Green shall be used to indicate that the valve is open.
 - c. Red shall be used to indicate a valve actuator fault or a valve out of position alarm.
 3. In addition to the color code for equipment statuses, text indicating when equipment is "Running" or "Not Running" and when equipment is "In Auto" or "Not In Auto" shall be displayed next to the equipment using blue text for indication that the text is dynamic. Blue shall be reserved only for dynamic text, excluding the analog process variables described below.
 4. Analog process variable displays shall use black text inside of a thin, dark gray border with light gray background. The text shall animate to white and the background shall animate to red during an alarm condition for the associated process variable (e.g., high level, low level, transmitter fail, etc.), and shall remain in that state until the alarm condition is cleared.
 5. Setpoint-entry boxes be sized similar to the analog process value displays, but shall instead use a thicker border. The background color for setpoint entry boxes shall be light green for process control and system setpoints and shall be light red for alarm setpoints.
 6. Text size and font requirements:
 - a. Font shall be Segoe UI Bold or Arial Bold.
 - b. Text for general labels on process screens and menus shall be size 12.
 - c. Text for value displays shall be size 14.
 - d. Text for process graphic titles and menu titles may be sized as needed by the software developer, minimum size 16.

7. OIP shall be programmed to allow each user to have a unique username and password. Provide the ability for specific users to be added or removed from and administration level directly from the OIP screen.
- E. Aeration Tank Blowers B-20-01, B-20-02, and B-20-03 shall each be controlled from this PLC with a SCADA On-Off switch as follows:
 1. In SCADA "On," the blower shall start and run continuously at an operator-adjustable speed setpoint (0 to 60 Hz).
 2. In SCADA "Off," the blower shall in operable
- F. Sludge Holding Tank Blower B-70-01 shall be controlled from this PLC with a SCADA Local-Off-Remote switch as follows:
 1. In SCADA "Local," the blower shall start and run continuously.
 2. In SCADA "Remote," the blower shall operate in a time-of-day mode as follows: Provide five sets of time of day (hour and minute) start and stop setpoints (10 setpoints total) such that when a start time is reached, the blower shall start and run until the stop time. Provide the ability to disable each time-of-day start and stop setpoint.
- G. RAS/WAS Pumps RASP-50-01 and RASP-50-02 shall each be controlled from this PLC with a SCADA Local-Off-Remote switch as follows:
 1. In SCADA "Local," the pump shall start and run continuously at an operator-adjustable speed setpoint (0 to 60 Hz).
 2. In SCADA "Remote," the operator shall be able to select either a "Constant Flow" or "Flow Pace" mode for control of the pumps as follows:
 - a. The operator shall be able to select which RAS pump(s) shall be in service. The operator shall have the ability to place one or both pumps in service.
 - b. In "Constant Flow" mode, there shall be an operator adjustable "Desired Flow" setpoint (0-500 gpm) to be maintained through the RAS Flow Meter (FIT-50-01). The PLC shall then control the pump speed in order to maintain the flow rate setpoint. If two pumps are selected for operation, they shall run at the same speed to maintain the required flow through FIT-50-01.
 - c. In "Flow Pace" mode, the pumps shall be flow paced based on the Effluent Flow (FIT-60-01). There shall be an operator adjustable desired percentage of the Effluent Flow (0-100%) that is to be returned by each RAS pump. The PLC shall then monitor the RAS flow (FIT-50-01) from the associated RAS pump(s) and control the pump speed in order to obtain the selected return flow rate. The calculated flow to be returned shall be displayed at the OIP screen. If two pumps are selected for operation, they shall run at the same speed to maintain the required flow through FIT-50-01. There shall be an operator-adjustable "High Effluent Flow" setpoint (0-500 gpm) to start the RAS pump speed reduction. Once the Effluent Flow (FIT-60-01) reaches the operator-adjustable "High Effluent Flow" setpoint, the RAS pump speed shall begin to reduce linearly as the Effluent Flow increases. There shall be an operator-adjustable "Stop Speed Reduction" setpoint (0-500 gpm) such that when the Effluent Flow reaches the "Stop Speed Reduction" setpoint the RAS pump speed shall remain constant and shall operate at an operator-adjustable minimum speed setpoint. Once the effluent flow falls below the "High Effluent Flow" setpoint, the RAS Pump shall resume normal operation as described above.
- H. Plant Drain Pumps P-80-01 and P-80-02 shall each be controlled from this PLC with a SCADA Local-Off-Remote switch as follows:
 1. In SCADA "Local," the pump shall be controlled from the start and stop pushbuttons at the unit.

2. In SCADA "Remote," the pumps shall be controlled based on the level in the wet well as determined from the submersible level transmitter (LT-80-01) and hardwired backup float switch controls as follows: There shall be operator-adjustable "Lead Pump Start," "Lag Pump Start," and "Common Pumps Off" level setpoints (0.0 to 12 feet) for control of the pumps. When the level in the wet well rises above the "Lead Pump Start" setpoint, the lead pump shall start and run continuously. If the level in the wet well continues to rise above the "Lag Pump Start" setpoint, the lag pump shall start and run continuously. Both pumps shall shut down when the level in the wet well falls below the "Common Pumps Off" setpoint.
3. Provide a Transducer-Auto-Backup Floats selector switch on the front of this SCC to allow the operator to select either the level transducer or the backup floats for control of the pumps.
 - a. In the "Transducer" mode, the pumps shall be controlled as described above and the backup float controls shall be disabled.
 - b. In the "Auto" mode, the pumps shall normally be controlled from the transducer as described above and the backup floats mode shall be enabled as follows:
 - (1) The hardwired backup floats shall be enabled when the level transducer in the wet well fails, when the low water level float switch (LS-80-01) is activated, or when the high water level float switch (LS-80-05) is activated. A "Backup Floats Mode Active" alarm shall be activated at the SCADA System to indicate that the system is in the "Backup Floats" mode. Once the "Backup Floats" mode has been engaged by a level transducer fail, the low water level float switch, or the high water level float switch, the pumps shall continue to be controlled from the backup floats as described under the "Backup Floats" mode until the system is manually reset by the operator using a reset pushbutton on the front door of this SCC or via the OIP.
 - (2) The "Transducer" and "Backup Floats" modes shall both be able to be manually set at the SCADA System.
 - c. In the "Backup Floats" mode, the pumps shall be controlled as follows: The three backup floats in the wet well (LS-80-02, LS-80-03, and LS-80-04) shall control the pumps as described below. This control shall be hardwired and not through the PLC.
 - (1) When the "Backup Floats" mode is enabled from the high level float switch, the lead and lag pumps shall both start. Provide hardwired adjustable time delays so that both pumps do not start simultaneously.
 - (2) When the "Backup Floats" mode is enabled from the selector switch or transducer fail, only the pump(s) being called-to-run from the float switches shall start. If more than one pump is being called-to-run, provide hardwired adjustable time delays so that the pumps do not start simultaneously.
 - (3) Once started, the pumps shall continue to run until the level in the wet well fails below the common pumps off float (LS-08-02). The pumps shall then be controlled from the lead pump start (LS-80-03), lag pump start (LS-80-04), and the common pumps off float switches. If the level in the wet well falls below the low level alarm float switch (LS-80-01), all running pumps shall shut down and an alarm shall be activated at the SCADA System. Based on the status of the float switches, hardwired start/stop signals shall be sent to the associated starters in the MCC.
 - d. Provide a blue pilot light on the front of this SCC to indicate that the system is in the "Transducer" mode and an pilot light on the front of this SCC to indicate that the system is in the "Backup Floats" mode. The selector switch and amber pilot lights shall be hardwired and not through the PLC.
4. Alternation of the pumps shall be through an operator-selectable "Fixed" mode or "Automatic" mode as follows:

- a. In the “Fixed” mode, the operator shall be able to select the lead pump with the unselected pump automatically becoming the lag pump. Alternation of the pumps shall be done manually by the operator in this mode.
 - b. In the “Automatic” mode, there shall be an automatic alternator within this PLC that shall rotate the pump sequence in a last-on, first-off sequence.
 - c. If any pump is called to run and fails to start (call-to-run fail) or is operating and fails (Motor Over-temperature, or SCADA/MCC not in “Remote”), the next pump in the sequence shall be rotated into the failed pump’s position.
- I. Influent and Effluent Samplers (SA-10-01 and SA-60-01) shall be controlled as follows: The Influent and Effluent Samplers shall each shall receive their required contact closures from this PLC for sampling. The operator shall be able to select either a flow-paced mode or a timed mode independently for each sampler for controlling the sampler’s operation as follows:
- 1. In the flow-paced mode, the operator shall be able to select the effluent flow (FIT-60-01) for controlling the sampler’s operation. The operator shall enter the total flow (in thousand gallons) between each sample. Once the total selected flow exceeds the setpoint, a contact closure shall be sent to the sampler. Coordinate the required contact closure duration with the sampler manufacturer.
 - 2. In the timed mode, the operator shall set the time between samples (0.1 to 24.0 hours). Once the timer expires, a contact closure shall be sent to the sampler.
 - 3. While operating in the flow paced or timed mode of control, the operator shall be able to override these modes and force a sample to be taken. The time or flow remaining to the next sample shall be reset after a manual sample is initiated.
 - 4. The SCADA System shall display the number of samples taken (per day) as well as flow (flow-paced mode only) or time (timed mode only) remaining until the next sample. Samples taken per day shall reset with the daily runtime and flow totalizers.
- J. Provide a Mission MyDro 150 RTU with PN OP653 Digital Input expansion module, PN OP465, Analog Input expansion module, antenna cable, antenna, and all associated mounting hardware. Missions RTU shall be installed within the SCC panel and antenna shall be installed on the exterior of the SCC panel.

3.04 PUMP, FLOAT SWITCH, AND TRANSDUCER CABLE JUNCTION BOXES

- A. Provide NEMA 4X, stainless-steel junction boxes, sized as required, where shown on the Drawings with terminal blocks for each associated pump, group of float switches, or transducer cable(s). Float switches/transducers shall be wired intrinsically safe.

3.05 MISSION ALARM SYSTEM

- A. Common fault alarm outputs to the Mission Alarm Dialer as shown in the SCADA System I/O Listing shall be provided for the following pieces of equipment.
 - 1. RAS/WAS Pumps (VFD Fault, Motor Overtemperature, and Call-to-run Fail).
 - 2. Final Clarifiers (Starter Overload, High Torque Shutdown, and Call-to-run Fail).
 - 3. Aeration and Post Aeration Blowers (VFD Fault, Motor Overtemperature, Starter Overload, High Discharge Air Temperature, and Call-to-run Fail).
- B. The Mission Alarm Dialer shall monitor a hardwired signal from the PLC scan fail relays in SCC-30 to indicate a PLC failure.

END OF SECTION

SECTION 26 09 10

CONTROLS AND INSTRUMENTATION DRAWINGS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01 33 00–Submittals.

1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 26 24 19–Motor Control, Section 26 09 00–Controls and Instrumentation, and drawings provided by equipment manufacturers for control panels provided with equipment specified in Division 46.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All drawings shall have the following information:
 1. Project information, including name of OWNER and specific project name.
 2. Drawing title, accurately representing what is on the drawing.
 3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
 4. System Supplier company name, address, and phone number.
 5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
 6. Revision block indicating revision number, date, description of revision, and person responsible for revision.
- B. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- C. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.
- D. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol Sheet shall include:
 - 1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
 - 2. List of abbreviations used on the drawings.
 - 3. Explanation of continuation method for circuits that cannot be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
 - 1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
 - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
 - 3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
 - 4. Equipment nameplate location.
 - 5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
 - 6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
 - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPSs, fiber optic patch panels, and lighting packages.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
 - 1. Back panel dimensions and finish.
 - 2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
 - 3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
 - 4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection Diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:
 - 1. Communications cables between system components (copper). This includes Ethernet patch cables between switches and devices.
 - 2. Communications cables (copper) between PLCs, controllers, operator interface equipment that are not shown on the elementary schematics.

- F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:
1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
 2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
 3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
 4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
 5. Documentation of PLC or controller inputs and outputs.
 6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.
 7. Documentation of all RVSS and VFDs (e.g., under-voltage shutdown, ramp time, overload, excessive starts/hour, etc.) which have been changed from the factory default settings.
- G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable. Information shown on System Supplier's wiring diagrams shall include a description of the drawings where terminations are found (i.e., drawing title), drawing number where the terminations are found, and terminal blocks referenced on the drawing. System Supplier shall coordinate with supplier of other wiring diagram to provide information on System Supplier's wiring diagrams.
- H. Calculations Summary: Calculations summary shall include calculations performed to:
1. Determine size of UPS.
 2. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.
- I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

3.03 SAMPLE DRAWINGS

- A. Sample drawings showing an acceptable format are included in the appendix. The samples included in the appendix do not represent the only acceptable method of showing the required information.

END OF SECTION

SCADA SYSTEM I/O LISTING

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	CONTROL POWER FAIL		1	0	0	0	2-#14	FROM CONTROL POWER FAIL RELAY IN SCC
30	NETWORK SWITCH ALARM		1	0	0	0	2-#14	FROM NETWORK SWITCH IN SCC
30	COMMON UPS ALARM		1	0	0	0	2-#14	FROM UPS IN SCC
30	MCC-30							
30	POWER FAIL		1	0	0	0	2-#14	FROM PHASE MONITOR IN MCC
30	SPD FAIL		1	0	0	0	2-#14	FROM SPD IN MCC
30	MCC-30 POWER METER							
30	VOLTAGE		0	0	X	0	ENET	FROM POWER METER IN MCC
30	CURRENT		0	0	X	0	ENET	FROM POWER METER IN MCC
30	KVAR		0	0	X	0	ENET	FROM POWER METER IN MCC
30	KW		0	0	X	0	ENET	FROM POWER METER IN MCC
30	FREQUENCY		0	0	X	0	ENET	FROM POWER METER IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM POWER METER IN MCC
30	TOTAL HARMONIC DISTORTION (VOLTAGE)		0	0	X	0	ENET	FROM POWER METER IN MCC
30	TOTAL HARMONIC DISTORTION (CURRENT)		0	0	X	0	ENET	FROM POWER METER IN MCC
30	GENERATOR							
30	RUNNING		1	0	0	0	2-#14	FROM GENERATOR CONTROL PANEL
30	FAILED		1	0	0	0	2-#14	FROM GENERATOR CONTROL PANEL
30	LOW FUEL LEVEL		1	0	0	0	2-#14	FROM GENERATOR CONTROL PANEL
30	FUEL TANK LEAK		1	0	0	0	2-#14	FROM GENERATOR CONTROL PANEL
30	BATTERY CHARGER FAIL		1	0	0	0	2-#14	FROM GENERATOR BATTERY CHARGER
30	GENERATOR AMPS		0	0	1	0	SH. PR.	FROM CT IN AUTOMATIC TRANSFER SWITCH
30	REMOTE E-STOP ACTIVATED		1	0	0	0	2-#14	FROM REMOTE EMERGENCY STOP PUSHBUTTON
30	AUTOMATIC TRANSFER SWITCH							
30	IN NORMAL POSITION		1	0	0	0	2-#14	FROM AUTOMATIC TRANSFER SWITCH
30	IN STANDBY POSITION		1	0	0	0	2-#14	FROM AUTOMATIC TRANSFER SWITCH
30	MECHANICAL FINE SCREEN	MFS-10-01						
30	MOTOR OVERTEMPERATURE		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	SCREEN RUNNING FAST		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	SCREEN RUNNING SLOW		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	VFD FAULT		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	SCREEN JAM ALARM		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	HIGH HIGH LEVEL ALARM	WSH-10-01	X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	SCREEN IN HAND		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	SCREEN IN AUTO		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	CONTROL PANEL E-STOP ACTIVATED		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	CONTROL STATION E-STOP ACTIVATED		X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	UPSTREAM HIGH WATER LEVEL	LSH-10-01	X	0	0	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	UPSTREAM LEVEL	LIT-10-01	0	0	X	0	ENET	FROM MFS-10-01 CONTROL PANEL
30	INFLUENT SAMPLER PULSE	SA-10-01	0	1	0	0	2-#14	TO SA-10-01
30	AERATION BLOWER NO. 1	B-20-01						
30	IN REMOTE		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	IN LOCAL		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
30	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
30	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD IN MCC
30	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
30	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
30	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS VIA VFD
30	HIGH DISCHARGE AIR TEMPERATURE	TSH-20-01	X	0	0	0	ENET	FROM TEMPERATURE SWITCH AT BLOWER VIA VFD
30	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
30	KW		0	0	X	0	ENET	FROM VFD IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM VFD IN MCC
30	AERATION BLOWER NO. 2	B-20-02						SAME AS B-30-01
30	IN REMOTE		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC
30	IN LOCAL		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC
30	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
30	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
30	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD IN MCC
30	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
30	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
30	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTATS VIA VFD IN MCC
30	HIGH DISCHARGE AIR TEMPERATURE	TSH-20-02	X	0	0	0	ENET	FROM TEMPERATURE SWITCH AT BLOWER VIA MCC
30	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
30	KW		0	0	X	0	ENET	FROM VFD IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM VFD IN MCC
30	AERATION BLOWER NO. 3	B-20-03						
30	IN REMOTE		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	IN LOCAL		X	0	0	0	ENET	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
30	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
30	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD IN MCC
30	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
30	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	MOTOR OVERTEMP		X	0	0	0	ENET	FROM MOTOR THERMOSTAS VIA VFD
30	HIGH DISCHARGE AIR TEMPERATURE	TSH-20-03	X	0	0	0	ENET	FROM TEMPERATURE SWITCH AT BLOWER VIA VFD
30	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
30	KW		0	0	X	0	ENET	FROM VFD IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM VFD IN MCC
30	SLUDGE HOLDING TANK BLOWER	B-70-01						
30	IN REMOTE		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	IN LOCAL		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	MOTOR OVERTEMPERATURE		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS VIA MCC
30	HIGH DISCHARGE AIR TEMPERATURE	TSH-70-01	1	0	0	0	2-#14	FROM TEMPERATURE SWITCH AT BLOWER VIA MCC
30	SECONDARY CLARIFIER NO. 1	SCD-40-01						
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	HIGH TORQUE ALARM	WSH-40-01	1	0	0	0	2-#14	FROM TORQUE SWITCH VIA MCC
30	HIGH TORQUE SHUTDOWN	WSHH-40-01	1	0	0	0	2-#14	FROM TORQUE SWITCH VIA MCC
30	SECONDARY CLARIFIER NO. 2	SCD-40-02						SAME AS SCD-40-01
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	HIGH TORQUE ALARM	WSH-40-02	1	0	0	0	2-#14	FROM TORQUE SWITCH VIA MCC
30	HIGH TORQUE SHUTDOWN	WSHH-40-02	1	0	0	0	2-#14	FROM TORQUE SWITCH VIA MCC
30	RAS/WAS PUMP NO. 1	RASP-50-01						
30	IN REMOTE		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	IN LOCAL		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
30	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
30	MOTOR OVERTEMPERATURE		X	0	0	0	ENET	FROM PUMP PROTECTION RELAY VIA VFD
30	SEAL FAIL		X	0	0	0	ENET	FROM PUMP PROTECTION RELAY VIA VFD
30	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
30	SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
30	SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD IN MCC
30	kW		0	0	X	0	ENET	FROM VFD IN MCC
30	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM VFD IN MCC
30	RAS/WAS PUMP NO. 2	RASP-50-02						

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	IN REMOTE		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	IN LOCAL		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH ON MCC VIA VFD
30	RUNNING		X	0	0	0	ENET	FROM VFD IN MCC
30	VFD FAULT		X	0	0	0	ENET	FROM VFD IN MCC
30	MOTOR OVERTEMPERATURE		X	0	0	0	ENET	FROM MINI CAS UNIT VIA VFD
30	SEAL FAIL		X	0	0	0	ENET	FROM MINI CAS UNIT VIA VFD
30	START/STOP		0	X	0	0	ENET	TO VFD IN MCC
30	VFD SPEED CONTROL		0	0	0	X	ENET	TO VFD IN MCC
30	VFD SPEED FEEDBACK		0	0	X	0	ENET	FROM VFD IN MCC
30	kW		0	0	X	0	ENET	FROM VFD IN MCC
30	AMPS		0	0	X	0	ENET	FROM VFD IN MCC
30	POWER FACTOR		0	0	X	0	ENET	FROM VFD IN MCC
30	RAS FLOW METER	FIT-50-01						
30	INSTANTANEOUS FLOW		0	0	1	0	SH. PR.	FROM MAGNETIC FLOW METER IN VALVE VAULT
30	TOTALIZED FLOW		1	0	0	0	2-#14	FROM MAGNETIC FLOW METER IN VALVE VAULT
30	PLANT DRAIN PUMP NO. 1	P-80-01						
30	IN REMOTE		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	IN LOCAL		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	MOTOR OVERTEMPERATURE		1	0	0	0	2-#14	FROM PUMP PROTECTION RELAY VIA MCC
30	SEAL FAIL		1	0	0	0	2-#14	FROM PUMP PROTECTION RELAY VIA MCC
30	PLANT DRAIN PUMP NO. 2	P-80-02						
30	IN REMOTE		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	IN LOCAL		1	0	0	0	2-#14	FROM L-O-R SELECTOR SWITCH AT UNIT
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	START/STOP		0	1	0	0	2-#14	TO STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	MOTOR OVERTEMPERATURE		1	0	0	0	2-#14	FROM PUMP PROTECTION RELAY VIA MCC
30	SEAL FAIL		1	0	0	0	2-#14	FROM PUMP PROTECTION RELAY VIA MCC
30	PLANT DRAIN PUMP STATION							
30	STATION LEVEL	LT-80-01	0	0	1	0	SH. PR.	FROM SUBMERSIBLE LEVEL TRANSMITTER JUNCTION BOX
30	LOW WATER LEVEL FLOAT SWITCH	LSL-80-01	1	0	0	0	2-#14	FROM FLOAT SWITCH JUNCTION BOX
30	COMMON PUMPS OFF FLOAT SWITCH	LS-80-01	1	0	0	0	2-#14	FROM FLOAT SWITCH JUNCTION BOX
30	LEAD PUMP START FLOAT SWITCH	LS-80-02	1	0	0	0	2-#14	FROM FLOAT SWITCH JUNCTION BOX
30	LAG PUMP START FLOAT SWITCH	LS-80-03	1	0	0	0	2-#14	FROM FLOAT SWITCH JUNCTION BOX

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	HIGH WATER LEVEL FLOAT SWITCH	LSH-80-01	1	0	0	0	2-#14	FROM FLOAT SWITCH JUNCTION BOX
30	IN TRANSDUCER MODE		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON THIS SCC
30	IN BACKUP FLOATS MODE		1	0	0	0	2-#14	FROM RELAY LOGIC IN THIS SCC
30	IN AUTO		1	0	0	0	2-#14	FROM SELECTOR SWITCH ON THIS SCC
30	SET TRANSDUCER MODE/RESET BACKUP FLOATS		0	1	0	0	2-#14	TO RELAY LOGIC IN THIS SCC
30	SET BACKUP FLOATS MODE		0	1	0	0	2-#14	TO RELAY LOGIC IN THIS SCC
30	UV DISINFECTION SYSTEM	UV-60-01						
30	LOW UV INTENSITY ALARM		1	0	0	0	2-#14	FROM UV-60-01 SYSTEM MONITOR
30	UV INTENSITY		0	0	1	0	SH. PR.	FROM UV-60-01 SYSTEM MONITOR
30	POST AERATION BLOWER	B-60-01						
30	RUNNING		1	0	0	0	2-#14	FROM STARTER IN MCC
30	STARTER OVERLOAD		1	0	0	0	2-#14	FROM STARTER IN MCC
30	MOTOR OVERTEMPERATURE		1	0	0	0	2-#14	FROM MOTOR THERMOSTATS VIA MCC
30	HIGH DISCHARGE AIR TEMPERATURE	TSH-60-01	1	0	0	0	2-#14	FROM TEMPERATURE SWITCH AT BLOWER VIA MCC
30	EFFLUENT CHANNEL							
30	pH	AE-60-01	0	0	1	0	SH. PR.	FROM pH ANALYZER
30	TEMPERATURE	AE-60-01	0	0	1	0	SH. PR.	FROM DO ANALYZER
30	DISSOLVED OXYGEN	AE-60-03	0	0	1	0	SH. PR.	FROM DO ANALYZER
30	TURBIDITY	AE-60-02	0	0	1	0	SH. PR.	FROM TURBIDITY ANALYZER
30	EFFLUENT SAMPLER PULSE	SA-60-01	0	1	0	0	2-#14	TO SA-60-01
30	EFFLUENT FLOW	FIT-60-01	0	0	1	0	SH. PR.	FROM FLOW METER TRANSMITTER
30	MISSION ALARM SYSTEM							
30	EFFLUENT FLOW		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	AMPS		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	VOLTAGE		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	pH		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	TEMPERATURE		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	DISSOLVED OXYGEN		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	TURBIDITY		0	0	0	1	SH. PR.	TO MISSIONS ALARM DIALER
30	POWER FAIL		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	GENERATOR FAILED		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	SCREEN HIGH-HIGH LEVEL		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	COMMON BLOWER FAULT		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	COMMON CLARIFIER FAULT		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	COMMON RAS PUMP FAULT		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER
30	LOW UV INTENSITY ALARM		0	1	0	0	2-#14	TO MISSIONS ALARM DIALER

STRAND ASSOCIATES, INC.
 SYCAMORE TRAILS WASTEWATER TREATMENT PLANT UPGRADES
 CONTRACT 1-2021
 WARREN COUNTY BOARD OF COMMISSIONERS
 SCADA SYSTEM I/O LISTING

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
30	PLANT DRAIN PUMP STATION HIGH LEVEL		0	1	0	0	2~#14	TO MISSIONS ALARM DIALER
	TOTALS		57	15	9	7		

SECTION 26 21 00

ELECTRICAL SERVICE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Utility company.
 - 2. Secondary service characteristics.
 - 3. Definitions.
 - 4. Underground electrical service.
- B. Allowances: CONTRACTOR shall include in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the Work required. Electric Utility Service Entrance, Section 1.07–Underground Electrical Service.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. See Division 01 for temporary service requirements. This section applies to permanent services only.

1.02 UTILITY COMPANY

- A. The Utility Company is Dayton Power and Light.

1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service will be 480/277-volt, 4-wire, three-phase for combined lighting and power.

1.04 DEFINITIONS

- A. Service: As defined in the NEC, Article 100.
- B. Primary Voltage: Above 600 volts.
- C. Secondary Voltage: 600 volts and below.

1.05 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items provided by the Utility Company.
- B. Provide electrical service system, except the Utility Company will provide:
 - 1. Transformer (pad by CONTRACTOR).
 - 2. Primary cable.

- C. Coordinate the new electrical service with the Utility. An allowance of \$15,000 shall be included in the Lump Sum Bid for the work provided by the Utility and will be adjusted at final payment in accordance with actual Utility charges. All other costs for the electrical service shall be included in the Lump sum Bid.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Motor control devices, accessories, and general requirements.
 - 2. Magnetic motor starters.
 - 3. Variable frequency drives.
 - 4. Motor control centers.

- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. All other sections of Division 26.

PART 1–GENERAL	1
1.01 SUMMARY.....	1
1.02 REFERENCES	1
1.03 QUALITY ASSURANCE.....	2
1.04 SUBMITTALS.....	2
1.05 OPERATION AND MAINTENANCE DATA	2
1.06 DELIVERY, STORAGE, AND HANDLING	2
1.07 COORDINATION	2
1.08 WARRANTY	3
PART 2–PRODUCTS.....	3
2.01 ACCEPTABLE MANUFACTURERS	3
2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS.....	3
2.03 MAGNETIC MOTOR STARTERS.....	5
2.04 VARIABLE FREQUENCY DRIVES.....	5
2.05 MOTOR CONTROL CENTERS	9
PART 3–EXECUTION	12
3.01 INSTALLATION	12

1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1–Molded Case Circuit Breakers.
- C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS-18–Motor Control Centers.
- E. NEMA KS 1–Enclosed Switches.
- F. NEMA PB 1–Panelboards.

- G. NEMA PB 1.1—Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Motor Control Equipment: Firms regularly engaged in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.
- B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, solid-state starters, variable frequency drives, combination motor starters, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Provide product data on motor starters and combination motor starters, VFDs, relays, pilot devices, and switching and overcurrent protective devices.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00—Submittals.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.07 COORDINATION

- A. To provide proper coordination between Section 26 09 00—Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00. This shall include, but not be limited to, equipment such as MCCs, and control stations. Drawings for MCCs, combination starters, motor controllers, and motor control equipment shall be provided by the Section 26 09 00 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters, variable frequency drives, and motor control centers shall be as manufactured by Allen-Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The drawings and specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified herein and shown on the drawings. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified herein and shown on the drawings. Indicating lights in exposed, outdoor locations shall be rated NEMA 4X.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified herein and shown on the drawings. Selector switches in exposed, outdoor locations shall be rated NEMA 4X.
- E. Contactors: NEMA ICS 2. All contactors for starters specified herein, including VFD and bypass starters, shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- F. Control Power Transformers: 240/120-volt secondary. Each motor starter shall have a dedicated control power transformer.
- G. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.

- H. Industrial control and power relays shall be installed in motor control centers, where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for lighting circuits or loads greater than 15 amps shall be industrial, electrically held power relays. Relays shall meet the following requirements:
1. Interposing/isolation relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC, or as required by System Supplier.
 - d. Contact rating: 8A (DPDT), 16 A (SPDT).
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700 HK, or equal.
 2. General purpose relays:
 - a. Configuration: DPDT or 3 PDT as required by system supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC.
 - d. Contact rating: 15 A, minimum; 3/4 hp.
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 3. Power relays.
 - a. Configuration: Electrically-held, 2-12 poles.
 - b. Mounting: DIN rail, square base.
 - c. Voltage: 120 VAC.
 - d. Contact rating: 20 A continuous; 1 hp.
 - e. Operating life: 10 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
 4. All timing relays shall have On and timing Out LEDs.
- I. Manufacturer of Accessories:
1. Terminal blocks shall meet the equipment of Section 26 05 19–Wire.
 2. Wire markers shall meet the requirements of Section 26 05 53–Electrical Identification.
- J. All motor control power shall be 120 volts with suitable protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- K. All starters shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each starter operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all starters shall be 120 volts.

2.03 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay. Starters for submersible pumps and motors installed outdoors shall include ground fault protection.
- B. Full-Voltage Starting: Nonreversing type as shown on the drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on the drawings. Contactors shall be Allen-Bradley, or Bulletin 509 (Nonreversing), or equal.
- E. Overload relays without Ethernet communications shall be Allen-Bradley E100, Bulletin 592-1EF, or equal, and have the following features:
 - 1. Self-powered, solid-state.
 - 2. Up to 5:1 adjustment range.
 - 3. DIP switch settings for trip class and reset mode.
 - 4. Current transformers (no heaters).
 - 5. Thermal memory.
 - 6. Ambient temperature compensation.
 - 7. Visible trip indicators.
 - 8. Phase loss protection.
 - 9. Low energy consumption.
 - 10. Ground fault protection as specified herein.

2.04 VARIABLE FREQUENCY DRIVES

- A. A variable frequency drive (VFD) system consists of enclosed inverter, motor starter, motor, and any additional system control as specified. VFDs shall be provided to match the load type (constant or variable torque) of the specification application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
 - 1. 480 VAC \pm 10%.
 - 2. Three-phase, 3-wire, any phase sequence.
 - 3. 60 Hz \pm 2%.
 - 4. Storage temperature -25°C to +55°C.
 - 5. Operating temperature 0 to 40°C.
 - 6. Altitude: 3,300 feet above sea level maximum.
 - 7. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
 - 1. Conform to NEMA and NEC standards.
 - 2. CSA and ETL approved and/or UL approved.
 - 3. Overall VFD efficiency shall be a minimum of 96.5%, \pm 1%, at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
 - 4. Input:
 - a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.

- b. Design shall include DC bus chokes (two) used in conjunction with one or more capacitors. The DC bus chokes shall be incorporated in the design to minimize line-side harmonics. Magnetic-only designs shall include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
 - c. Include MOV line-side protection.
 - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range.
 - e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
 - f. Three percent line reactors (drives smaller than 100 hp).
 - g. Drives larger than 40 hp shall include fuses on the drive input. Fuses shall be provided with indicating-type fuse blocks as manufactured by Bussman Model JM60 including see-through covers with integral open fuse indicating lights for each fuse.
5. Inverter Output:
- a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
 - b. Match motor specified.
 - c. Three-phase, 3-wire.
 - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
 - e. Maximum output 460 volts.
 - f. Frequency 2 to 650 Hz.
 - g. Frequency accuracy $\pm 1\%$ of setting at any point in the specified speed range in a 24-hour period.
 - h. Full load output current shall be rated a minimum of 20% in excess of the AC motor selected.
 - i. Motor performance:
 - (1) 3% regulation in the manual speed control mode.
 - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
 - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
 - (4) 110% starting torque minimum.
6. AC drive features:
- a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, and separate acceleration and deceleration adjustments from 0 to 3600 seconds. An internal manual speed potentiometer is to be provided for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
 - b. Slot-based architecture for expansion control and communication cards including Ethernet/IP, ControlNet, DeviceNet, Modbus TCP, discrete I/O, and analog I/O.
 - c. Real-time clock with battery for date/time stamping of events.
 - d. Integral thermostat control of door-mounted cooling fans.
 - e. Current limit circuitry: 20% to 160% of drive-rated amps.
 - f. Additional features for constant torque units shall include:
 - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
 - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
 - (3) Inner current loop regulator.

7. Enclosures:
 - a. The VFD system shall be furnished with NEMA-rated (as previously specified) floor mounting MCC structure or structures. MCC structures shall be 91 1/2 inches high by 20 inches deep with a width to accept the unit specified. MCC structure shall incorporate bus where field wiring can be reduced.
 - b. Items to be mounted in the VFD structure or structures:
 - (1) Inverter.
 - (2) Incoming door interlocked, magnetic, molded-case circuit breaker.
 - c. NEMA 4/13 items to be door-mounted on the MCC structure or portion of the structure:
 - (1) Control devices, pilot lights, selector switches, etc., as shown on the drawings and specified herein.
 - (2) Interface to the drive shall be via a removable human interface module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.
8. Interlocks:
 - a. Fault contact to terminals.
 - b. VFD run contact to terminals.
9. VFD protection:
 - a. Adjustable current limit of 20 to 160% minimum.
 - b. Instantaneous overcurrent trip.
 - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 VAC $\pm 10\%$. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
 - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
 - e. Shut down on loss of any input phase for longer than 3 cycles.
 - f. Output phase sequence to be independent of input phase sequence.
 - g. High- or low-sustained voltage.
 - h. 120 VAC grounded control circuits.
 - i. Electrically and/or optically isolated low voltage logic.
 - j. Corrosion protection:
 - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
 - (2) Protective board coating (conformal coating).
 - k. MOV converter protection.
 - l. DC bus chokes to minimize line side current harmonics.
 - m. Additional features for constant torque units:
 - (1) I²T protection to provide 150% current for one minute.
 - (2) Regenerative override protection.
10. VFD adjustments:

- a. Maximum speed: 30 to 60 Hz.
 - b. Minimum speed: 0 to 42 Hz.
 - c. Current limit: 20 to 110%, 160% on constant torque units.
 - d. Linear acceleration 0 to 3,600 seconds.
 - e. Linear deceleration 0 to 3,600 seconds.
 - f. Output volts/Hz trim.
 - g. Voltage boosts.
 - h. Additional features for constant torque units:
 - (1) Slip compensation.
 - (2) IR compensation.
 - i. All drives shall attempt to restart three times prior to indicating failure.
11. Inverter digital or LED diagnostic features:
- a. Current limit signal.
 - b. Regenerative override signal.
 - c. External fault (e.g., motor overload).
 - d. Low line voltage.
 - e. High line voltage.
 - f. Current overload.
 - g. High DC bus voltage.
 - h. Current trip.
 - i. Short-circuit.
12. Inverter construction:
- a. Modular construction for ease of maintenance.
13. Mount modules on enclosure subpanel:
- a. Easily accessible from front.
 - b. Interconnect with plugs.
 - c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.
- D. Inverter Quality Control:
- 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
 - 2. Test integrated circuits for programmed parameters at rated temperature.
 - 3. Treat printed circuit boards for corrosion resistance (conformal coating).
 - 4. Provide gold-plated connections at all points where plugs are used.
 - 5. Thermal cycle all printed circuit boards for 10 cycles between 0°C to 65°C prior to installation in inverter.
 - 6. All units to be tested at a rated load and temperature after assembly.
- E. The 6-pulse variable speed drives shall be Allen-Bradley, or equal, Powerflex 753. All drives shall be by the same manufacturer.
- F. Drive manufacturer shall provide a dv/dt sine wave output filter on the output of each drive. Output filter shall be manufactured by Allen-Bradley, model 1204-TFB2, or equal. Dv/dt filter shall be manufactured by TCI, Model V1K Series, or equal. Sine wave filter shall be manufactured by TCI, Model KMG, or equal. Output filter shall be installed at the motor. Sine wave dv/dt filter shall be installed in MCC bucket.
- G. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served. CONTRACTOR shall provide a table listing the minimum, maximum, and skip setpoints programmed into each VFD on the project to ENGINEER and OWNER.

- H. Provide expansion I/O cards, quantity as required, so that signals noted in the I/O list are transmitted/received to/from the plant SCADA System via the Ethernet network.
- I. Provide single-port, 100BASE-TX Ethernet communications module (20-COMM-E) supporting the Ethernet/IP protocol for each drive so that signals noted in the I/O List–Section 26 09 90 are transmitted/received via the plant SCADA System Ethernet network.
- J. Provide manufacturer certified start-up and warranty service for each VFD. Service shall be for 2 years and include all travel and expenses. Warranty service shall commence at the date of substantial completion.

2.05 MOTOR CONTROL CENTERS

- A. Starters, VFDs, and disconnect devices for motors shall be installed in MCCs. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. The MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00–Controls and Instrumentation. MCC drawings provided by the MCC manufacturer or through any contractor will not be accepted as shop drawing submittals or O&M documents. System supplier described in Section 26 09 00–Controls and Instrumentation shall wire and test all MCCs for the functions described herein in its shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.
- B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard. Color shall match that specified for control enclosures specified in Section 26 09 00–Controls and Instrumentation.
- C. Auxiliary contacts shall be of quantity necessary for equipment functions.
- D. MCC design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.
- E. Structures shall be totally enclosed, dead front, free-standing vertical sections, 90 inches high and not less than 20 inches deep for front-mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault-propagation to adjacent sections.
- F. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical bus feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical bus of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground bus. All bus shall be tin-plated copper and braced to withstand short-circuit currents as indicated.
- G. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and accessible without disrupting service.

- H. A vertical wireway with a minimum of 28 square inches of cross-sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wireways shall be free of all live parts and shall contain vertical wireway tie bars. Exceptions to this are as shown on the drawings.
- I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.
- J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.
- K. All disconnect operating handles located higher than 6 feet 7 inches above finished floor in the on position (including the MCC pad height) shall be provided with handle extensions. All disconnect operating handles above this height must operate in the vertical direction.
- L. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus; no wiring to these stabs shall extend into the bus compartments. All bus access openings shall be provided with automatic shutters that close when the unit (e.g., starter, breaker) is withdrawn.
- M. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory-wired. Provide a minimum of 25% spare terminals for all terminal blocks furnished.
- N. Control centers shall be NEMA Class II.
- O. Wiring in control centers shall be Type B. All conductors supplying power from the MCC bus to frame-mounted equipment shall have the phases identified as specified in Section 26 05 53–Electrical Identification.
- P. Provide neutral landing lugs for all MCCs accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground bus at the utility service entrance, unless otherwise noted.
- Q. Control centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.
- R. Remote-mounted controls shall be heavy-duty, oiltight (30 mm) of same quality and type furnished in starters and as shown on the drawings. Equipment controls that require a manual reset shall be accomplished through a reset push button on the enclosure or MCC bucket for the associated piece of equipment. All reset buttons shall be appropriately labeled, including mechanical type.
- S. MCC enclosures must be in accordance with area designations shown on the drawings.
- T. All lighting and small power transformers shall be dry type, Class H insulation, DOE 2016 Efficiency rated, 115°C rise (kVA as indicated on drawings). Coil windings shall be copper, glass-taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480-volt primary, Delta with 120/208-volt, three-phase, 4-wire secondary, unless indicated otherwise. Circuit breakers that feed lighting panel transformers shall be provided with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide

adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.

- U. All lighting panelboards shall be Eaton Pow R-Line 1a, or equal, with 10,000 amps interrupting capacity, at 120/208-volt, three-phase, 4-wire with branch breakers as shown on the drawings, unless indicated otherwise. Branch-mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be aluminum. Provide laminated, typewritten panel schedule for all panelboards at project final completion.
- V. All motor control centers shall be factory-assembled, wired, and tested. All internal wiring shall be numbered, and each wire shall be terminated on terminal strips, including internal spares, field wiring, and spare field wires. Schematic and wiring layout drawings following JIC Standards which show all connections to external devices, a complete bill of materials, and a detailed description of operation, shall be submitted for each piece of equipment.
- W. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.
- X. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be stainless steel screw on type. Nameplates located indoors shall be adhesive type.
- Y. Unless otherwise indicated, all conduit entrances shall be through the bottom only.
- Z. MCC interrupting rating shall be as shown on the drawings, minimum 42,000 A.
- AA. The main breaker or main lugs of each MCC shall be provided with a surge protection device and a three-phase monitor. This surge protection device shall be on the load side of the main and be as specified in these specifications. SPD red and green LED indicators, to indicate if one or more modules have reduced protection and if power is present on each phase, shall be displayed on the front of the bucket door. The three-phase monitor shall be on the load side of the main and be Timemark *269, or equal. CONTRACTOR shall select voltage to match electrical service.
- BB. Each MCC shall be provided with a power meter and appropriately sized metering-class current transformers (CTs) installed on the load side of the MCC main breaker. Power meter shall be Allen-Bradley PowerMonitor 1000, Bulletin 1408-EM3A-ENT, or equal. CTs shall be Allen-Bradley Bulletin 1411-180-XXX or 1411-8SHT-XXX as required for monitoring parallel phase conductors, or equal, and shall be rated for ANSI/IEEE C57.13 metering Class 0.3 or 0.6 accuracy. Provide CT cabling as specified in Section 26 05 23–Instrument and Communication Wire and Cable, for the specified CT accuracy class, minimum 14 AWG. Power meter shall be provided with an Ethernet/IP communications module matching the SCADA System communication protocol so that all readings can be monitored at the SCADA System HMI. Power meter shall be mounted in a dedicated MCC bucket, where shown on the Drawings. The MCC bucket shall be provided with a control power transformer, fused disconnects for the control power circuit and voltage sensing lines, and CT shorting blocks as specified in Section 26 05 19–Wire.
- CC. Main Breaker: Molded case circuit breaker, three-pole, amperes as shown on the drawings with lugs for 480-volt, three-phase, 4-wire, 60-cycle entrance. When main

breaker is the disconnecting means for a structure, breaker shall be service entrance rated.

- DD. Main and feeder circuit breakers shall be provided in accordance with the requirements specified in Section 26 28 00–Overcurrent Protective Devices.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer’s instructions and drawings.
- B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.
- C. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.
- D. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- E. Wireways in MCCs shall be used only for routing of conductors. Splices are not allowed within wireways.
- F. All wiring within MCCs shall be landed on terminals inside buckets or equipment compartments and not left unterminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.
- G. Motor Data: Provide neatly typed label inside each motor starter enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- H. Control wiring and field wiring (120 V and below) within MCCs shall be separated from power wiring (277 V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.
- I. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- J. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, VFDs, disconnect switches, etc.
- K. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.

- L. Provide motor controllers as specified for all motors, unless shown or specified that motor controllers or control equipment will be furnished by others.
- M. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Cover plates.
 - 4. Ceiling-mounted occupancy sensors.
 - 5. Thermostats.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA WD 1–General-Color Requirements for Wiring Devices.
- B. NEMA WD 5–Specific-Purpose Wiring Devices.
- C. Drawings–Bill of Materials.

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2--PRODUCTS

2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Eaton 122*, Leviton 122*, or Pass and Seymour PS20AC*.
- B. Provide ivory-colored handles.

2.02 RECEPTACLES

- A. Twenty ampere, 125-volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Eaton 5362, Leviton 5362, Pass and Seymour 5362. Provide ivory color.
- B. Weather-Resistant Receptacle: Weather-resistant receptacles shall include GFCI protection and be UL498 listed, twenty ampere, 125-volt, NEMA 5-20R, heavy-duty, commercial grade, with WR marking on the face, Eaton WRSGF20, or equal.
- C. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Pass and Seymour 2097, Eaton TRSGF20 receptacle with integral ground fault current interrupter. Provide ivory color.

2.03 COVER PLATES

- A. Surface boxes shall have plates to match Crouse-Hinds, Appleton, or equal, cast boxes.
- B. Weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, Eaton S2983 or equal.
- C. While in use receptacle covers for exterior use shall be Leviton IUM1V-GY, or equal.

2.04 THERMOSTATS

- A. Line voltage thermostats for single-stage heating or single-stage cooling, and for high- and low-temperature alarms shall be PECO Model TF115-001, or equal. Thermostats shall be rated NEMA 4X with a 40°F to 110°F temperature range and fixed 3°F deadband.

PART 3--EXECUTION

3.01 INSTALLATION

- A. All receptacles shall be mounted vertically.
- B. Weather-resistant receptacles shall be provided in all damp and wet locations.
- C. GFCI receptacles shall not be series wired.

- D. Install wall switches 48 inches above floor (top of box), "Off" position down, except as otherwise noted.
- E. Install convenience receptacles shown to be "above furniture" 36 inches above floor (bottom of box), grounding pole on bottom except as otherwise noted.
- F. Install convenience receptacles 15 inches above floor (bottom of box), grounding pole on bottom except as otherwise noted.
- G. Install thermostats 48 inches above floor (top of box).
- H. Install devices and cover plates flush and level.
- I. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- J. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be White background with Black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.
- K. Individually adjust each occupancy sensor's sensitivity and install sensor shields as required such that the sensor properly serves movement in all areas of the room, but does not energize lighting due to movement in adjacent rooms or due to ambient noise in the space when unoccupied (e.g., noise from pumps, refrigerators, HVAC equipment, servers, etc.). Adjust off-delay timers as required so that sensors operate in a manner that is acceptable to OWNER.

END OF SECTION

SECTION 26 28 00

OVERCURRENT PROTECTIVE DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00–Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I²t curves, and manufacturer’s detailed specifications.

1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
 - 1. NFPA 70 National Electrical Code (NEC).
 - 2. Local codes and ordinances.
 - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00–Materials and Equipment.
- 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.

PART 2–PRODUCTS

2.01 CIRCUIT BREAKERS

- A. General:
 - 1. Comply with UL 489 requirements.
 - 2. Provide thermal and magnetic protection unless noted otherwise.
- B. Main Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Provide solid-state circuit breakers with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide ground fault trip with integral adjustable ground fault pickup and delay settings, adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.

- C. Feeder Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Solid-state Circuit Breakers:
 - a. Circuit breakers with frame sizes 400 amperes and larger shall be provided with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
 - b. Circuit breakers in motor control centers that feed lighting panel transformers shall be provided with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
 - 3. Field-Adjustable Thermal-Magnetic Trip Circuit Breaker: NEMA AB1. Provide circuit breakers with frame sizes less than 400 amperes with mechanism for adjusting instantaneous pickup setting for automatic operation. Range of adjustment shall be three to ten times the trip rating.
 - 4. Field-Changeable Magnetic-Only Ampere Rating Circuit Breakers/Motor Circuit Protectors: UL 489. Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.

- D. All lugs shall be rated to accept copper conductors.

2.02 ENCLOSURES

- A. Circuit breakers shall be installed within MCC, panelboard, etc. as shown on the Drawings.

2.03 ACCESSORIES

- A. Provide accessories as scheduled as listed below:
 - 1. Handle lock: Include provisions for padlocking.
 - 2. Provide mechanical trip device.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

3.02 ADJUSTMENT

- A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Disconnect switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110 or Eaton Type DH.
- B. Manual Motor Switches: Square D Class 2510 Type K or Eaton B330.
- C. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

- A. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

2.03 SINGLE-PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 26 27 26–Wiring Devices for additional information.

2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
 - 1. Indoor dry locations: NEMA 12, steel.
 - 2. Outdoor or wet locations: NEMA 4X, stainless steel.
 - 3. Hazardous locations: NEMA 7, cast aluminum.
- B. Provide manual motor switch enclosures as listed below, unless noted otherwise on the Drawings.
 - 1. Indoor dry, outdoor, or wet locations: NEMA 4, die cast zinc.
 - 2. Hazardous locations: NEMA 7, cast aluminum.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to ENGINEER based on field conditions.
- B. Provide wall switch for each single-phase fractional horsepower motor where indicated on the drawings.
- C. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.
- D. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

SECTION 26 32 13
STANDBY POWER SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Steel base assembly, diesel engine, generator, engine-generator set controls, environmental systems.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. The following listing of related sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this work. All other sections of Division 26.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawings shall include the following:
 - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
 - 2. Detailed layouts of all equipment and ancillary items.
 - 3. The manufacturer shall furnish schematic and wiring diagrams for the generator and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.
- C. Submit forms required in Section 3.01.G., to Ohio Building Code Official, ENGINEER, and OWNER.

1.03 QUALITY ASSURANCE

- A. The generator shall be listed by Underwriters Laboratories, Inc., UL2200, and be certified by the Canadian Standards Association.

1.04 OPERATING CONDITIONS

- A. Engine-generator set shall be capable of continuous standby rating at 1,800 rpm, 0.8 PF, three-phase, 3-wire, 480 volts, at 60 hertz, and shall have a minimum capability of 136 kW, 170 kVA prime and 150 kW, 188 kVA standby.
- B. The generator set manufacturer shall verify the engine as capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperature expected in service, and the altitude of the installation. Site conditions are 95°F maximum ambient and 800 feet altitude.

- C. Voltage regulation shall be $\pm 0.5\%$ of rated voltage for any constant load between no load and rated load.
- D. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed $\pm 0.25\%$.
- E. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed $\pm 0.5\%$ of rated voltage for constant loads from no load to rated load, with constant ambient and operating temperature.
- F. Total Harmonic Distortion: The sum of AC voltage wave-form harmonics shall meet NEMA MG1 and shall not exceed 5% of rated voltage (L-N, L-L, L-L-L), and no single harmonic shall exceed 3% of rated voltage.
- G. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
- H. The engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- I. Motor starting capability shall be a minimum of 540 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25%.

1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The AC engine-generator set shall be as manufactured by Kohler Model 150REOZJF, or Caterpillar.
- B. The drawings and specifications were prepared based on Kohler. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 STEEL BASE ASSEMBLY

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
- B. The steel base assembly shall be provided with an integral fuel tank with a minimum usable fuel capacity of 460 gallons as required to provide a minimum continuous runtime of 24 hours at full load without re-fueling. A fuel gauge shall be mounted within the tank. The fuel tank shall be furnished with a rust preventative coating. The fuel tank shall be pressure tested for a minimum of 2 hours to provide its integrity. The fuel tank shall be UL-142 listed and labeled, and include secondary containment. Fuel tank shall be Ohio-labeled and manufactured in accordance with the Ohio Building Code and the Ohio Fire Code. CONTRACTOR shall obtain tank installation plan review and written approval from the Ohio Building Code Official and the Ohio State Fire Marshall and local fire department or authorized agent per the Ohio Building Code Official prior to tank installation. All costs associated with plan approval shall be included in the bid. The subbase tank shall include a 5-gallon spill containment area.
- C. Provide a low-level alarm activated at 30% for fuel tank with spare contacts for remote indication.
- D. Provide a float switch in the rupture basin for remote indication of fuel tank leak.

2.03 ENGINE

- A. The engine shall be stationary, liquid-cooled, diesel for use with No. 2 diesel fuel. The design shall be 4-cycle, 6-cylinder, minimum displacement of 415 cubic inches, turbo charged, after cooled as required by engine manufacturer. Engine shall be certified as capable of driving the generator of the rating indicated above on a continuous standby basis for the duration of normal source interruptions.
- B. Engine accessories shall include the following:
 - 1. A 24-volt DC electric starter as required by the engine manufacturer.
 - 2. Replaceable dry element air cleaner with restriction indicator.
 - 3. Positive displacement, mechanical, full-pressure lubrication oil pump, full-flow lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension. Provide all lubricants for proper operation of the unit.
 - 4. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed.
 - 5. Engine protective devices to indicate alarm and engine shutdown for the following:
 - a. Low coolant temperature alarm.
 - b. Low coolant level alarm and shutdown.
 - c. Low lubrication oil pressure alarm and shutdown.
 - d. High coolant temperature alarm and shutdown.
 - e. Over-speed shutdown.

- f. Over-crank shutdown.
- 6. Battery charging alternator, 45 amp minimum, with solid-state voltage regulator.
- 7. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Rotating parts shall be guarded against accidental contact. The cooling system shall be rated for full-rated load operation in a 104°F ambient condition. Radiator shall be provided with a duct adaptor flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall. Provide radiator drain extension to the side of the generator. Extension shall include shutoff valve.
- 8. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
- 9. Engine-mounted thermostatically controlled coolant heater to aid in quick starting. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104°F in a 40°F ambient, in compliance with NFPA 110 requirements. Heater shall be rated single-phase, 120 volts, 1,800 watts and be disconnected whenever the engine starts. Heater shall be UL 499 listed and labeled. The coolant heater(s) shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. CONTRACTOR shall provide proper circuit from normal utility power source.
- 10. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
- 11. Flexible fuel lines, fuel strainer, and fuel solenoid. CONTRACTOR shall install fuel lines and fuel solenoid per manufacturer's recommendations.

2.04 ENGINE EXHAUST SYSTEM

- A. Exhaust muffler shall be provided for the engine of size as recommended by manufacturer. Muffler shall be of the critical grade-type.
- B. Stainless steel flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line in compliance with applicable codes and regulations.
- C. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation to prevent condensation from entering the engine.
- D. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.

2.05 STARTING AND CONTROL BATTERIES

- A. A UL-listed/CSA-certified 10-ampere voltage regulated battery charger shall be provided for the engine-generator set.
- B. Charger shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
- C. The charger shall be compliant with UL 991 requirements for vibration resistance.
- D. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL labeled with the maximum battery amp-hour rating

that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200 AH batteries in accordance with NFPA requirements.

- E. The charger shall incorporate a 4-rate charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
- F. The DC output voltage regulation shall be within $\pm 1\%$. The DC output ripple current shall not exceed 1 amp at rated output current level.
- G. The charger shall include the following features:
 - 1. Two-line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
 - 2. LED indicating lamps to indicate normal charging (green), equalize charge state (amber), and fault condition (red).
 - 3. AC input overcurrent, over voltage, and under voltage protection.
 - 4. DC output overcurrent protection.
 - 5. Alarm output relay.
 - 6. Corrosive-resistant aluminum enclosure.
- H. Two calcium/lead antimony storage battery set of the heavy-duty starting-type shall be provided. Battery voltage shall be compatible with starting system. Each battery set shall be rated no less than 570 CCA and shall be capable of a minimum of three 15-second cranking cycles. A battery rack constructed in conformance with NEC requirements and necessary cables and clamps shall be provided for each battery.

2.06 GENERATOR

- A. The generator shall be a single prelubricated bearing, self-aligning, 4-pole, two-thirds pitch, brushless, synchronous-type, revolving field with amortisseur windings, and with direct driven centrifugal blower fan for proper cooling and minimum noise. No brushes will be allowed. Generator shall be directly connected to engine fly wheel housing and driven through a flexible coupling to provide permanent alignment. Generator design shall prevent potentially damaging shaft currents.
- B. Insulation shall meet NEMA standards for Class H and shall be UL 1446 listed. The maximum temperature rise shall not exceed 125°C at 40°C ambient.
- C. The generator shall be three-phase, broad-range, reconnectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
- D. The generator set shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- E. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.

- F. The subtransient reactance of the alternator shall not exceed 15%, based on the standby rating of the generator set.
- G. Provide a 300 amp mainline circuit breaker with the engine-generator set. Circuit breaker shall meet the requirements specified in Section 26 28 00–Overcurrent Protection.

2.07 ENGINE-GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The generator set mounted controls shall include the following features and functions:
Control Switches:
 - 1. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 2. EMERGENCY STOP switch: Switch shall be Red “mushroom-head” pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
 - 3. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 4. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- C. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
 - 1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current (all three phases), frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
 - 2. The control system shall log total number of operating hours and total kWh, as well as total values since reset.
- D. Generator Set Alarm and Status Display:
 - 1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
 - a. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
 - b. The control shall include a flashing red lamp to indicate that the control is not in automatic state and red common shutdown lamp.
 - c. The control shall include an amber common warning indication lamp.
 - 2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:
 - a. Low oil pressure (warning).

- b. Low oil pressure (shutdown).
 - c. Oil pressure sensor failure (warning).
 - d. Low coolant temperature (warning).
 - e. High coolant temperature (warning).
 - f. High coolant temperature (shutdown).
 - g. High oil temperature (shutdown).
 - h. Low coolant level (shutdown).
 - i. Fail to start/overcrank (shutdown).
 - j. Overspeed (shutdown).
 - k. Low DC voltage (warning).
 - l. High DC voltage (warning).
 - m. Weak battery (warning).
 - n. Low fuel tank (warning).
 - o. High AC voltage (shutdown).
 - p. Low AC voltage (shutdown).
 - q. Under frequency (shutdown).
 - r. Overcurrent (warning).
 - s. Overcurrent (shutdown).
 - t. Short circuit (shutdown).
 - u. Overload (warning).
 - v. Emergency stop (shutdown).
 - w. Four configurable conditions.
3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. All contacts shall be rated for 5 amps at 120 VAC. Relays shall be provided when necessary. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The nonautomatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- E. Engine Status Monitoring:
- 1. The following information shall be available from a digital status panel on the generator set control:
 - a. Engine oil pressure (psi or kPA).
 - b. Engine coolant temperature (degrees F or C).
 - c. Engine oil temperature (degrees F or C).
 - d. Engine speed (rpm).
 - e. Number of hours of operation (hours).
 - f. Number of start attempts.
 - g. Battery voltage (DC volts).
 - 2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set.
- F. Engine Control Functions:
- 1. The control system provided shall include a cycle cranking system which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15-second rest period between cranking periods and a 75-second overcrank lockout per NFPA 110.
 - 2. Manual Run/Stop Control Switch: When the mode control switch is in the MANUAL position and the MANUAL RUN/STOP switch is pressed, the Generator set shall start, bypassing time delay start. If the generator set is running in the MANUAL mode, pressing the RUN/STOP switch shall cause the generator set to shut down after a cool-down at idle period.

3. The control system shall include an engine governor control which functions to provide steady state frequency regulation, as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
4. The control system shall include sensor failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sensor or wiring components, and an actual failure conditions.

G. Alternator Control Functions:

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (overcurrent warning) when load current exceeds 110% (adjustable) of the rated current of the generator set on any phase for more than 60 seconds (adjustable). The device shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
3. A microprocessor-based protection device shall be provided to monitor all phases of the output current for short-circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (short-circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
4. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds (adjustable). Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. A microprocessor-based AC over and undervoltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% (adjustable) of the operator-set voltage level for more than 10 seconds (adjustable), or with no intentional delay when voltage exceeds 130% (adjustable). Undervoltage shutdown shall occur when the output voltage of the alternator is less than 85% (adjustable) for more than 10 seconds (adjustable). The system shall monitor individual phases and be connected line to neutral on three-phase 4-wire generator sets and for systems that are solidly grounded.

- H. A common fail contact for remote indication at the SCADA system shall be provided. All contacts shall be rated for 5 amps at 120 VAC.
- I. Generator control panel shall be mounted a maximum of 5 feet 6 inches above finished floor. CONTRACTOR shall be responsible for all required coordination.

2.08 WEATHER-PROTECTIVE GENERATOR ENCLOSURE

- A. Generator set weather-protective housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electrocoating paint process, or equal, meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
 - 1. Primer thickness 0.5 to 2.0 mils. Top coat thickness 0.8 to 1.2 mils.
 - 2. Gloss according to ASTM D523, 80% \pm 5%. Gloss retention after 1 year shall exceed 50%.
 - 3. Crosshatch adhesion according to ASTM D3359, 4B-5B.
 - 4. Impact resistance according to ASTM D2794, 120-inch pounds to 160-inch pounds.
 - 5. Salt spray according to ASTM B117, 1000+ hours.
 - 6. Humidity according to ASTM D2247, 1000+ hours.
 - 7. Water soak according to ASTM D2247, 1000+ hours.
- B. Painting of hoses, clamps, wiring harnesses, and other nonmetallic service parts shall not be acceptable. Fasteners used shall be corrosion-resistant and designed to minimize marring of the painted surface when removed for normal installation of service work.
- C. The enclosure shall include hinged doors for access to both sides of the engine and alternator and the control equipment. Key locking and padlockable door latches shall be provided for all doors. All hardware and door hinges shall be stainless steel. All doors shall be provided with door stops to hold them in the open position.
- D. The enclosure shall include flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure, with internal drain valves and external radiator fill provision.
- E. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure. Silencer exhaust shall include a raincap and rainshield.
- F. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100°F. The enclosure shall reduce the sound level of the generator set while operating at full-rated load to a maximum of 75 dBA at any location, 7 meters from the generator set in a free-field environment.
- G. The enclosure shall be insulated with nonhygroscopic materials.

2.09 TOOLS AND SPARE PARTS

- A. The required spare parts for the generator shall be those as recommended by the manufacturer and shall include the following items as a minimum:
 - 1. All special tools required for normal operation and maintenance.

2. One air cleaner element.
 3. One oil filter.
 4. One set of fan belts.
- B. All spare parts shall be packed in containers that are clearly identifiable with indelible markings on containers.

2.10 LABELING AND SIGNS

- A. Provide the following warning signs/placards on each of the long sides of the generator enclosure.
1. Flammable Liquids Sign: Sign shall be of a durable material. Sign shall have white lettering on a red background and shall read: "DANGER-FLAMMABLE LIQUIDS." Letters shall be not less than 3-inches in height and 1/2-inch in stroke.
 2. No Smoking Sign: Sign shall be of durable material. Sign shall have white letter on red background and shall read: "NO SMOKING WITHIN 25 FEET OF THIS ENCLOSURE." Letters shall be not less than 3-inches in height and 1/2-inch in stroke.
 3. Material Placard: Placard shall be of durable material, such as adhesive-backed plastic. Placard shall comply with NFPA 704 Hazard Identification System as to size, information displayed, and color coding.
- B. Sign/placard wording, size, and color shall be approved by the Authority Having Jurisdiction during shop drawing review.
- C. Signs/placards shall be shipped loose for installation by CONTRACTOR.

2.11 SCHEDULED OIL SAMPLING

- A. In order to minimize engine downtime, the supplier of the standby generator must provide an oil-sampling analysis kit that operating personnel shall use for scheduled oil sampling.
- B. Scheduled oil sampling shall be of the atomic absorption spectrophotometry method and shall be accurate within a fraction of one part per million for the following elements: iron, chromium, copper, aluminum, silicon, and lead. In addition, the sample shall be tested for the presence of water, fuel dilution, and antifreeze.
- C. All equipment needed to take oil samples shall be provided in a kit at the time of acceptance and shall include the following:
1. Sample extraction gun (1).
 2. Bottles (10).
 3. Postage paid mailers (10).
 4. Written instructions (1).
- D. Immediate notification shall be provided to OWNER when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.
- E. The scheduled oil-sampling kit shall be made available at additional cost to OWNER beyond the mandatory starter kit specified previously and shall be optional for OWNER to continue this service after the starter kit has been depleted.

2.12 GENERATOR EMERGENCY SHUTDOWN PUSHBUTTON CONTROL STATION

- A. Furnish a red mushroom head, maintained-type pushbutton control station for manual initiation of a generator emergency shutdown. When the emergency stop pushbutton is pressed, the generator shall shut down and remain shut down until the emergency stop pushbutton is manually reset and the generator is called to run.
- B. The control station shall be labeled "Generator Emergency Shutdown."
- C. The control station shall be provided with a NEMA 4X, stainless steel enclosure and two sets of N.O. and N.C. contacts to monitor signal at the generator.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The standby power system shall be installed as shown on the drawings and in accordance with the manufacturer's recommendations and all applicable codes.
- B. Installation of equipment shall include providing all interconnecting wiring between all major equipment provided for the on-site power system. CONTRACTOR shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. All connections (e.g., fuel, water, electrical) to generator shall be made with flexible material/fitting to accommodate unit vibration.
- D. Equipment shall be initially started and operated by representatives of the manufacturer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- F. Generator fuel storage tank and system shall be installed by a certified installer in accordance with the Ohio Building Code and the Ohio State Fire Code.
- G. CONTRACTOR shall furnish copies of an Aboveground Petroleum Product Tank Inventory Form, Flammable Liquid Tanks Installation Application Form, and Checklist for Aboveground Tank Installation Form to the Ohio Building Code Official, ENGINEER, and OWNER.
- H. Submit all required documents to the Office of the Ohio Department of Commerce Division of the State Fire Marshal] to obtain aboveground storage tank permit for the subbase fuel tank. Permit shall also be submitted to ENGINEER and OWNER. Coordinate with the Office of the Illinois State Fire Marshall to conduct any required inspections following installation of the subbase tank.
- I. CONTRACTOR shall install signs and placards furnished by the equipment supplier.

- J. CONTRACTOR shall perform an on-site vacuum test of the subbase fuel tank and submit results to ENGINEER, OWNER, and the State Fire Marshall.

3.02 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional testing of the system. Upon completion of the manufacturer's start-up and testing, the manufacturer shall generate a site start-up and test report, documenting all systems checked, as well as any incomplete work remaining and operational deficiencies.
- C. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal work day (not including start-up) at a job-site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly and major components within the assembly.
- D. CONTRACTOR shall provide three copies of the manufacturer's site start-up and test report to ENGINEER for review. Once ENGINEER has reviewed the report and all equipment is operating in accordance with the specifications, ENGINEER will make one site visit to check operation of the system. If the system is not ready or does not operate as specified, OWNER shall deduct payment to CONTRACTOR and make payment to ENGINEER for additional travel, expenses, and site visits until the equipment operates as specified. CONTRACTOR shall be responsible for all fuel, and electrical costs required to check operation of the system.

3.03 TESTING

- A. In addition to the standard factory tests, there shall be a 4-hour continuous load bank test at the jobsite before connection to load transfer switch, with loads from 10% to 100% of rated capacity to check voltage, frequency, fuel, air cooling, and ventilating systems so that they can be determined adequate for the application. This test shall be accomplished with a portable three-phase resistive load bank. All emergency warning and detection equipment shall be demonstrated to be operable by simulating failures. A signed test report shall be submitted to OWNER and ENGINEER with deficiencies noted, if any. After this test, the generator shall be connected to the plant and the operation and maintenance of the unit comprehensively demonstrated to OWNER. Correct phasing between the engine-generator and station shall be verified so that it will handle load. A minimum of two power failures shall be simulated.
- B. In addition to the load bank test above, after the unit is connected to the system, three simulated outages and a 4-hour run period on the actual facility shall also be provided.
- C. CONTRACTOR shall be responsible for all fuel costs for these tests.

END OF SECTION

Section 26 32 13-12

4640.003/1-2021

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Provide an automatic transfer switch control system where shown on the drawings.
 - 2. The system shall be a completely integrated assembly for automatic, unattended operation and control of the standby power system. System operation shall be as described in the following sections.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawings shall include the following:
 - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
 - 2. Detailed layouts of all cubicles and equipment.
 - 3. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

1.03 QUALITY ASSURANCE

- A. The transfer switch shall be listed by Underwriters Laboratories, Inc. (Std. 1008) and be approved by the Canadian Standards Association.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The automatic transfer switch shall be as manufactured by Kohler KCP, 400-amp, 3-pole, or equal.

- B. The drawings and specifications were prepared based on Kohler. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 AUTOMATIC TRANSFER SWITCHES

- A. Provide complete automatic transfer switch as shown on the Drawings. Interlocked molded case circuit breakers or contactors are not acceptable.
- B. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a nonventilated enclosure constructed in accordance with Underwriters Laboratories, Inc., UL 1008. The transfer switch shall be open-type and provided in a MCC construction enclosure as specified in Section 26 24 19–Motor Control.

2.03 CONSTRUCTION AND PERFORMANCE

- A. The transfer switch shall be double-throw, actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple overcenter linkage, with a minimum transfer time of 400 milliseconds.
- B. The transfer switch shall have the ability to detect under and over-voltage, under and over-frequency, voltage imbalance, incorrect phase rotation, and phase loss.
- C. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer.
- D. The transfer switch shall allow the motor and transformer loads to be reenergized after transfer with normal inrush current. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.
- E. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs and shall be silver tungsten alloy. All contacts shall be 100% rated. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches.
- F. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.
- G. The transfer switch shall be equipped with a digital display that has the ability to monitor load power conditions, network status, review transfer switch events, and adjust transfer switch parameters. The display shall also include a bar graph display that indicates the level of power being supplied to the load as well as three-phase voltage, current, frequency, power factor, and kilowatts. The digital display shall be mounted on the front of the MCC enclosure door such that the operator does not have to open the door to operate the display.
- H. Provide a current transmitter (CT), as manufactured by Veris Industries, Hawkeye H-Series, or equal, with 4-20 mA output for installation on the phase B conductors from the transfer switch to the generator.

2.04 SEQUENCE OF OPERATION

- A. Engine starting contacts shall be provided to start the generating plant should the voltage of the normal source drop below 80% on any phase after an adjustable time delay to allow for momentary dips. The transfer switch shall transfer to standby when 90% of rated voltage and frequency has been reached. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time delay period of zero to 31 minutes shall delay retransfer to allow stabilization of normal power. If the standby power source should fail during this time delay period, the switch shall automatically return to the normal source. After retransfer to normal, the engine-generator shall be allowed to operate at no-load for a period of 5 minutes. Two auxiliary contacts rated 25 amps, 120 volts shall be mounted on the main shaft; one closed on normal, the other closed on standby. All relays, timers, control wiring, and accessories shall be front accessible. In addition, one set of relay contacts shall be provided to open upon loss of the normal power supply. All control wire terminations are to be identified by tubular sleeve-type markers.

- B. The automatic transfer switch shall include the following functions. Adjustable time delays and features described below shall be operator-adjustable from the front of the transfer switch and shall not require the use of a laptop, software, or external programming device.
 - 1. Time delay to override momentary normal source power outages to delay engine start signal and transfer switch operation. Adjustable 0.5 to 90 seconds.
 - 2. Time delay relays to control contact transition time on transfer to either source, adjustable 1 to 300 seconds (Programmed Transition).
 - 3. Time delay on retransfer to normal. Adjustable 0 to 31 minutes, with engine overrun to provide fixed 5-minute unloaded engine operation after retransfer to normal.
 - 4. Test with load-Auto-Test without load selector switch to simulate normal power failure. (Maintained Type).*
 - 5. Contact to close on failure of normal source to initiate engine starting or other customer functions.
 - 6. Contact to open on failure of normal source to initiate engine starting or other customer functions.
 - 7. Green pilot light to indicate switch in normal position.*
 - 8. Red pilot light to indicate switch in standby position.*
 - 9. Auxiliary contact closed in normal position.
 - 10. Auxiliary contact closed in standby position.
 - 11. Adjustable relay to prevent transfer to standby until voltage and frequency of generating plant have reached acceptable limits.
 - 12. Plant exerciser with 7-day time clock, multiple test schedules, and programmable exceptions for holidays, weekends, etc.

* Front cabinet door mounted.

- C. When coordinated with circuit breakers, the automatic transfer switch shall have the following short-circuit withstand capability:

Withstand Capability (RMS Amps, Symmetrical) Testing at 480 VAC			
Switch Ampere Rating	ATS Coordinated with Molded Case Circuit Breakers		
150 to 1,000	14,000	30,000	65,000

- D. During the withstand tests, there shall be no contact welding or damage. The tests shall be performed on identical samples without the use of current limiting fuses. Oscillograph traces across the main contact shall verify that contact separation has not occurred. These

procedures shall be in accordance with UL 1008 and testing shall be certified by Underwriters Laboratories or any nationally recognized independent testing laboratory.

- E. When conducting temperature rise tests to UL 1008, the manufacturer shall include postendurance temperature rise tests to verify the ability of the transfer switch to carry full-rated current after completing the overload and endurance tests.
- F. As a precondition for approval, the manufacturer of the automatic transfer switch shall verify that the switches are listed by Underwriters Laboratories, Inc., UL 1008 with withstand and close-in values at least equal to the interrupting rating of the circuit breaker and/or fuse that is specified to protect the circuit.

PART 3–EXECUTION

3.01 INSTALLATION

- A. The installation of this system shall comply with the directions and recommendations of authorized factory representatives. These representatives shall offer the supervision necessary for proper installation.
- B. A final inspection and an initial start-up of the system shall be provided by the factory representatives.
- C. A letter of certification written by the authorized factory representatives which states that the system is properly installed and does properly function as recommended by the factory and as described herein shall be submitted to ENGINEER.
- D. A test run shall be performed by the authorized factory representatives in the presence of CONTRACTOR and ENGINEER or their representatives; the time of this test run shall be mutually agreed upon by all persons concerned.

3.02 START-UP AND TRAINING

- A. CONTRACTOR shall include 8 hours of start-up by a certified, factory-trained engineer. Start-up services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the ATS assembly. On-site time shall be over and above the cost of travel and travel time to the site.
- B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal workday (not including start-up) at a job site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly, simulated outages, and review of major components within the assembly.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES (SPD)

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70, and 75.
- C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

- A. Manufacturers of surge protective devices. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 20-year warranty from the date of substantial completion to cover repair or replacement of the device. This warranty shall include the field replaceable plug-in modules and coordinated fuses.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The drawings and specifications were prepared based on MCG. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy transient voltage (service entrance) surge suppressors. The specified surge protective device shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 (service entrance) and location category B3 (branch panels). Testing shall be per ANSI/IEEE C62.45–2002 using ANSI/IEEE C62.41 Category C3 and B3 waveforms and amplitudes.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.
- K. SPD shall be suitable for use in Type 2 locations.

- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt systems.
 - 1. L-N = 1500 V.
 - 2. L-G = 1500 V.
 - 3. N-G = 1200 V.
 - 4. L-L = 2500 V.

2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life (8/20) shall be at least 6 kA for 10,000 occurrences or 10 kA at 20 kV for 16,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating (I_n) of 10 kA.
- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 100 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. Service entrance devices shall be as manufactured by MCG, 160M Series, Liebert 560 Series, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed within the motor control center. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to ENGINEER, may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible.
- D. Manufacturer shall provide protection modules and coordinated fuses under a no-cost lifetime replacement warranty.

END OF SECTION

SECTION 26 51 13

LIGHTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
 - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.
- F. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture and lighting controls installation by CONTRACTOR. Completed means lamped, cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features,

accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals. Shop drawings shall include, but not be limited to, the following:
 - 1. Manufacturer’s dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents.
 - 2. Installation instructions.
 - 3. Certified photometric test data and reports.
 - 4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
 - 5. Submittal should include, but not be limited to, wattage, lumen output, color temperature, and CRI value.

1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and other appurtenances shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
 - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
 - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
 - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 6. Wattage shall be equal to that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.

2.02 WIRING

- A. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 26 05 19–Wire.
- B. Wiring within fixture construction shall be concealed, except where the fixture design or mounting dictates otherwise.

- C. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
- D. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.03 LED DRIVERS

- A. General:
 - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated in the model numbers in the fixture schedule shown on the Drawings.
 - 2. Driver shall have a minimum rated life of 50,000 hours.
 - 3. Driver shall have a minimum power factor of 0.9 and a maximum crest factor of 1.5 at full input power and across the specified voltage range.
 - 4. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 - 5. Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.
 - 6. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - 7. Fuse Protection: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected per Class 2 UL listing.
 - 8. All fixtures located outdoors shall be provided with surge protection.

2.04 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install fixtures, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. All wall-mounted fixtures and all ceiling-mounted surface fixtures including exit lights, shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- C. All exterior wall-mounted fixtures shown over doorways shall be mounted centered, 6-inches above doorway, unless otherwise noted.
- D. All fixtures shall be securely and adequately supported and installed.
- E. Surface- or pendant-mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fixtures shall be supported by not fewer than two supports for each fixture. Where fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly from the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture

weight of greater than 25 pounds shall have safety cable installed, in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression type. Cables must be secured to the building structure and to a point or points on the fixture to protect against falling parts.

- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room shall be located at the height of the lowest fixture, but not lower than 8 feet 0 inches above the finished floor. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after the installation of other equipment.
- G. Provide inscription for exit and area of rescue assistance signs to conform to codes.
- H. Metal decking shall not be pierced for fixture support.
- I. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

3.02 SUPPORTS

- A. Mounting Frames: Provide mounting frames (plaster frames for example), as necessary, for installation and as required under other sections. Frames shall be finished matte white baked enamel unless otherwise noted.
- B. Mounting Accessories: Fixtures shall be securely attached to prevent movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall be of a positive, locking type, and shall not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.
- C. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the Drawings and provide appropriate mounting accessories for each lighting fixture.
- D. Pendant Mounting: Provide pendant- or surface-mounted fixtures with required mounting accessories, including hickey, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the drawings, or established in the field.
- E. Adequate rigid, sturdy support shall be provided to prevent the possibility of fixture falling. Surface and pendant fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot sections shall have three supports. All pendants must have swivel aligners located at the top ends; pendants shall be minimum 3/8-inch threaded rod inside 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the Drawings, pendant supports shall be painted on jobsite. Support surface-mounted fixtures from structural members other than ceiling tees by providing Unistrut members spanning main ceiling tees or by mounting directly to structure.

3.03 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units), shall be adjusted after dark under the observation of OWNER.

3.04 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., shall be installed prior to the finishing assembly which shall not be installed until the Project is at Final Completion. When the fixture location or construction prevents sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.05 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
 - 1. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
 - 2. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.
 - 3. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 26 95 10

SPARE PARTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Spare parts for applicable sections of Division 26 as noted below.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute, and other standards pertaining to material, construction, and testing where applicable.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory winter-proof wrapping intact. Provide factory-wrapped waterproof flexible barrier metal for factory packaging of equipment and material to protect against physical damage in transit. When applicable, equipment stored shall be in factory coverings in a clean, dry, indoor space which provides protection against the weather.
- B. All spare parts shall be suitably boxed or wrapped to prevent deterioration and shall be completely identified on the outside.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Spare parts specified herein shall be provided by the same manufacturer as the equipment provided on the project.

2.02 MOTOR CONTROL

- A. The following shall be furnished:
 1. Two spare fuses for each type of control and current-limiting fuse provided.
 2. One set of fuses for each VFD and Reduced Voltage Solid-State Starter size (horsepower) provided.
 3. One replacement relay for each type of relay provided, including time-delay relays.

2.03 CONTROLS AND INSTRUMENTATION

- A. The following shall be furnished.
1. 10% of PLC communication cards, minimum of one each.
 2. One PLC processor and PLC power supply.
 3. 10% of PLC input/output cards for each type provided (analog and discrete), minimum one each.
 4. Two transient/spike suppressors.
 5. One network switch.

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 31 10 00
CLEARING AND GRUBBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Cutting and disposing of trees, brush, windfalls, logs, and other vegetation.
 - 2. Removing and disposing of roots, stumps, stubs, logs, and other timber.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

3.02 PROTECTION

- A. CONTRACTOR shall protect from damage utilities and structures that are to remain.
- B. CONTRACTOR shall protect trees, plant growth, and features designated to remain as final landscaping.
- C. See Division 01 for protection of survey monumentation.

3.03 CLEARING AND GRUBBING

- A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the drawings, designated to be removed on the drawings or in the specifications, or fall within the excavation, embankment, or improved areas of the site.
- B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.
- C. Disposal by burning or burying clearing and grubbing items within the project limits is not allowed.

END OF SECTION

SECTION 31 23 00

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
 - 1. Excavating for footings, foundations, roads, utilities, sidewalks, driveways, parking lots, restoration, and miscellaneous areas.
 - 2. Furnishing and placing all fill and backfill.
 - 3. Provide compaction of all fill and backfill.
 - 4. Furnishing and placing vapor barrier and granular cushion below interior slabs on grade.
 - 5. Furnishing and placing of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
 - 6. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Allowances: CONTRACTOR shall INCLUDE in the Bid a total of \$15,000 for the cost of field density tests and other geotechnical testing services. This allowance shall be adjusted by change order (up or down), based on the actual cost of tests to CONTRACTOR. Cost of additional field density tests required because of suspected or actual nonconformance of the Specifications shall be borne by CONTRACTOR and shall not be included in the allowance.
- D. Payment: Common excavation shall include all excavation specified, undercutting, fill, backfill and grading, including rock excavation and unsuitable foundation material, as hereinafter described.

1.02 REFERENCED STANDARDS

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Ohio Department of Transportation, Construction and Material Specifications, current edition, including all issued supplemental specifications.
- B. ASTM C33—Standard Specification for Concrete Aggregates.
- C. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- D. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

1.03 SUBMITTALS

- A. Submit sources and gradations for materials proposed for use as compacted fill, utility trench backfill, trench bedding and cover material, crushed stone mat, and granular cushion.

- B. Submit samples of materials proposed for use in Paragraph 1.03.A to a soils testing laboratory for analysis of its suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- C. Submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information is included in an appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

PART 2-PRODUCTS

2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. A minimum 65% of the material shall pass the 3/4-inch sieve, and the material shall be capable of being compaction tested in accordance with ASTM D1557, as determined by the Project Soils Engineer. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.
- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

2.02 CRUSHED STONE MAT

- A. Crushed stone mat below tank slabs, manholes, vault slabs and basement floors shall be 3/4-inch clear crushed stone and shall meet all requirements of Item 703 of Standard Specifications.

2.03 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements of size Nos. 8 or 57 of Item 703 of Standard Specifications.

2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined in Section 03 30 00 Cast-In-Place Concrete or flowable fill as defined in this section.

2.06 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

2.07 FLOWABLE FILL

- A. Flowable fill shall be provided in accordance with Item 613, Type 2, of the Standard Specifications.
- B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:
 1. Gradation of fine aggregate.
 2. Design mix.
 3. Previous test results with 7- and 28-day compressive strengths.
 4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 5. Brand, type, principle ingredient, and amount of each admixture if used.

2.08 TRENCH BEDDING MATERIAL

- A. Bedding material shall be hard and durable and shall be made by crushing sound limestone or dolomite ledge rock, or crushed gravel aggregate. Bedding material shall conform to the requirements of ASTM C33 and shall conform to gradations shown in Table 2.08.A. No native soil shall be used for bedding material.

TABLE 2.08.A
PERCENTAGE BY WEIGHT PASSING INDICATED SIEVE

Size	2 1/2 IN	2 IN	1 1/2 IN	1 IN	3/4 IN	1/2 IN	3/8 IN	No. 4	No. 8	No. 16	No. 50	No. 100	No. 200
57			100	95-100		25-60		0-10	0-5				
8						100	85-100	10-30	0-10	0-5			
9							100	85-100	10-40	0-10	0.50		
10							100	85-100				10-30	

- B. All rigid sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on the Drawings. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.

- C. Concrete and other rigid pipe used in nonsanitary sewer applications may be bedded using the Class C bedding detail as shown on the Drawings. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- D. Ductile and cast iron pipe shall be bedded in accordance with Class C bedding detail as shown on the Drawings, or the Type 4 laying condition of AWWA C600. Bedding material shall conform to Size No. 57, No. 8, or No. 9. Where ductile iron pipe is polyethylene encased, bedding material shall conform to Size No. 8 or No. 9.
- E. Thermoplastic sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on the Drawings. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- F. All other sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on the Drawings. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- G. PVC water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with the Type 4 laying condition of AWWA C605. HDPE water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on the Drawings or in accordance with ASTM D2774. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used. No native materials may be used.
- H. Bedding material for copper water services shall conform to Size No. 9 or No. 10.

2.09 TRENCH COVER MATERIAL

- A. Material which is to be placed from the bedding material to 1 foot above the top of the pipe shall be termed cover material. All trenches shall be backfilled by hand to 1 foot above the top of the pipe with cover material. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. Use special care in placing cover material to avoid injury to or movement of the pipe. Cover material shall consist of durable granular particles ranging in size from fine to a maximum size of 3/4 inches. Unwashed bank run sand and crushed bank run gravel will be considered generally acceptable cover material. Cover material shall generally conform to the following gradation specifications:

TABLE 2.09.B
COVER MATERIAL GRADATION

Sieve Size	Percentage by Weight Passing
1 inch	100
3/4 inches	85 to 100
3/8 inches	50 to 80
No. 4	35 to 65
No. 30	--
No. 40	15 to 30
No. 200	5 to 15

- B. Native trench materials may be used for cover material if they substantially conform to the above gradation specifications and a suitable credit is extended to OWNER.
- C. All bedding materials may be substituted for cover material when requested by CONTRACTOR except where polyethylene encasement is used. In such case, only those bedding materials specifically noted for polyethylene encasement may be used.
- D. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4-inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be Size No. 10. Cover material for PVC pressure or other thermoplastic piping may be Size No. 10.

2.10 TRENCH BACKFILL MATERIAL

- A. Backfill shall be that material placed between the top of cover material up to subgrade for placement of restoration materials. Backfill for storm inlets shall be bedding material.
- B. When the type of backfill material is not otherwise specified or shown on the Drawings, CONTRACTOR may backfill with the excavated material, provided that such material consists of loam clay, sand, gravel, or other materials which, in the opinion of Project Soils Engineer, are suitable for backfilling.
- C. All backfill material shall exceed a temperature of 35°F and be free from frost, cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, or stone, frozen lumps, or other material which in the opinion of Project Soils Engineer is unsuitable. From 1 foot above the top of the pipe to the trench subgrade, well-graded material containing stones up to 8 inches in their greatest dimension may be used, unless otherwise specified. Care should be taken in backfilling so as not to damage the installed pipe.
- D. In refilling the trench, if there is not sufficient material excavated therefrom suitable for refilling, CONTRACTOR shall, without extra compensation, furnish the deficiency. Where indicated on the Drawings, fill shall be provided over projecting conduits. Such fill shall be free of large boulders, and the top 6 inches shall be of suitable material to fit the adjoining ground.
- E. When called for on the Drawings, in the specifications, or requested by ENGINEER, backfill material shall be granular and shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids in the coarse material. No stones over 3 inches or clay lumps shall be present. Unless otherwise allowed by ENGINEER, granular backfill shall be provided in accordance with materials for Item 304 of the Standard Specifications.

PART 3-EXECUTION

3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.
- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for setting and establishing finish elevations and lines.
- B. Where lasers are used, CONTRACTOR shall check the Work against intermediate grade stakes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- C. If existing property stakes, not within the limits of the trench or street slope limits, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

3.04 COMMON EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.
- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.

- C. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19—Dewatering.
- F. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- G. When excavations reach subgrade elevations as shown on Drawings or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified, shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- H. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.
- I. CONTRACTOR shall backfill and compact all overexcavated areas.

3.05 UTILITY TRENCH EXCAVATIONS

- A. Caution In Excavation; CONTRACTOR shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures may be determined and shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on its part.
- B. Subsurface Exploration: When determined that it is necessary to explore and excavate to determine the location of existing underground facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is asked to perform additional Work in making the explorations and excavations, extra compensation will be allowed as specified In the General Conditions.
- C. The trench shall be dug so that the utilities can be laid to the alignment and depth specified. Unless otherwise allowed by ENGINEER, trenches shall not be excavated more than 100 feet in advance of pipe laying. Earth excavation shall include all excavation except rock. Included in earth excavation shall be removal of street paving of all types, existing structures, existing improvements and trees smaller than 4 inches in diameter measured 4 feet above the ground, all as necessary to complete the pipe installation.
- D. The trench shall be finished to the depth necessary to provide a uniform and continuous bearing and support for the pipe on the bedding material provided at every point between bell holes. Any part of the bottom of trench excavated below the specified grade shall be corrected with bedding material, thoroughly compacted in place. The bedding shall be shaped and finished with hand tools to fit the bottom quadrant to the pipe.

- E. If unstable soil conditions are encountered at subgrade, CONTRACTOR shall replace the unstable soil with special bedding. CONTRACTOR shall be allowed extra compensation for the special bedding, unless the unstable soil conditions are caused by CONTRACTOR's failure to adequately dewater the trench, in which case CONTRACTOR shall bear the entire cost.
- F. All excavated material shall be piled in a manner that will not endanger the Work. Stockpiles not for immediate backfilling shall have silt fences placed around their perimeter for erosion control. The Work shall be conducted in such a manner that pedestrian and motor traffic is not unnecessarily disrupted. Fire hydrants, valve boxes and manholes shall be left unobstructed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.
- G. Excavated material designated by ENGINEER as being undesirable for backfilling and all surplus excavated material shall be immediately removed as excavation progresses. All such material shall be disposed of in an environmentally safe manner in accordance with local, state, and federal regulations. No such materials shall be disposed of in wetlands, floodplains, or other environmentally sensitive areas. Disposal sites are also subject to approval of OWNER. All undesirable and surplus material disposed of must be leveled off and graded to rough elevations as determined by OWNER. Appropriate erosion control measures shall be provided and maintained at disposal sites until disposal is complete and the disposal site is permanently stabilized.
- H. CONTRACTOR shall remove bituminous pavement and road surface as a part of the trench excavation. The width of pavement removed shall be the minimum possible, and acceptable, for convenient and safe installation of utilities and appurtenances.
- I. All bituminous pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the trench.
- J. Where it is necessary to trench through concrete pavement, a strip shall be sawed and removed in such a manner as not to disturb the remainder of the pavement. Paving and undermining of existing concrete pavement shall be prevented by CONTRACTOR. If CONTRACTOR unnecessarily removes or damages pavement or surfaces beyond limits acceptable to ENGINEER, such pavement and surfaces shall be replaced or repaired at the expense of CONTRACTOR.
- K. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
- L. Pipe shall be placed only on dry foundations.
- M. Excavation shall include all necessary incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling.
- N. CONTRACTOR shall excavate whatever materials, are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown.
- O. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to

underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions

- P. Any water, drainage, gas sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance within the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- Q. CONTRACTOR shall be responsible for determining and providing the minimum width necessary to provide a safe trench in accordance with current OSHA standards and all other applicable standards. The top width of trench excavation shall be kept as narrow as is reasonably possible and acceptable to minimize pavement damage. Pay items related to maximum trench widths shall not limit CONTRACTOR's responsibility to provide safe trench conditions.
- R. Width of Trench–Rigid Pipe: The width of trench below the outside top of the pipe shall be as shown in the following table for the sizes listed. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching. If sheeting is used and is going to remain in place, the trench width shall be measured as the clear distance between inside faces of the sheeting. Otherwise, the trench width shall be based on the width between stable trench walls after sheeting is removed.

MAXIMUM WIDTH OF TRENCH BELOW TOP OF PIPE

Nominal Pipe Diameter (Inches)	Trench Width (Inches)
4	30
6	30
8	36
10	36
12	36
15	36

- S. Where the width of trench below the outside top of the pipe barrel cannot be otherwise maintained within the limits shown above, CONTRACTOR, at its own expense, shall furnish an adequate pipe installation for the actual trench width which will meet design conditions. This may be accomplished by furnishing higher class bedding, a stronger pipe, concrete cradle, cap or envelope or by driving sheeting prior to excavation to subgrade. Removal of sheeting below the top of the pipe, if allowed by ENGINEER, shall be gradual during backfilling.
- T. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle, cap, sheeting, bedding or the stronger pipe shall be placed by CONTRACTOR at its own expense. Where the maximum trench width is exceeded at the written request of ENGINEER, the concrete cradle, cap, sheeting, bedding or stronger pipe will be paid for on the basis of the price bid.

- U. Width of Trench—Thermoplastic and Ductile Iron Pipe: The trench width for flexible pipe shall be minimum three times the pipe outside diameter or the maximum trench width specified for rigid pipe, whichever is greater. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching.
- V. Special bedding shall consist of stone material and filter fabric as described herein. Where the bottom of the trench at subgrade is found to be unstable or of unsuitable material, which should be removed, CONTRACTOR shall excavate and remove such unstable or unsuitable material to the trench width and to a depth of 2 feet. The excavated area shall be lined with filter fabric, Mirafi 140 N, US Fabrics US 120NW, Propex Geotex 401, or equal, and backfilled with bedding material in maximum 12-inch layers. At subgrade the filter fabric shall be wrapped over the special bedding with an 18-inch overlap. Bedding material shall then be placed over the special bedding to support the piping. See Dewatering and Excavation to Subgrade sections for additional conditions.
- W. If soil conditions require it, concrete cradle or encasement shall be placed around the pipe as shown on the Drawings. Excavation shall be carried below the grade line to a depth requested by ENGINEER and concrete cradle or encasement placed. Before the concrete is placed, the pipe shall be laid to line and grade, blocked and braced, and the joint made. The cradle shall then be placed, taking care not to disturb the pipe. Concrete shall have a minimum 28-day compressive strength of 4,000 psi. Concrete cradle shall not be used for thermoplastic piping. See Trench Width section for additional conditions.
- X. Open-cut trenches shall be sheeted and braced as required by any governing federal regulations including OSHA, state laws, and municipal ordinances; and as may be necessary to protect life, property, improvements or the Work. Underground or aboveground improvements to be left in place shall be protected and, if damaged, shall be repaired or replaced at the expense of CONTRACTOR.
- Y. Sheet piling and bracing which is to be left in place must be removed for a distance of 4 feet below the present or proposed final grade of the street, road, or land, whichever is lower. Trench bracing, except that which shall be left in place, may be removed after backfilling has been completed or has been brought up to such an elevation as to permit its safe removal.
- Z. Portable Trench Box: Whenever a portable trench box or shield is used, special precautions shall be taken so as not to pull already jointed pipe apart or leave voids around the pipe wall. Whenever possible, the bottom edge of the box shall be kept at a level approximately even with the top of pipe. Cover material shall be placed to at least the top of pipe before moving the box ahead.
- AA. All trenches shall be backfilled using specified material so that excessive lengths of trench are not left open. In general, the backfilling operation shall proceed so that no more than 100 feet of trench is open behind the pipe laying operation.
- BB. Backfill shall be left below the original surface to allow for placement of restoration materials including pavement, base course, concrete, topsoil, sod, plus any pavement replacement specified in accordance with the Asphaltic Paving section herein. When settlement occurs, CONTRACTOR shall restore the surface improvements at its expense to maintain the finished surface.

3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.
- D. Where requested by ENGINEER in the field, excavation below subgrade areas shall be lined with geotextile material as specified in Section 31 32 19 and backfilled with No. 2 aggregate.
- E. Geotextile shall be placed where requested by ENGINEER to stabilize street subgrade areas. Fabric shall be as specified in Section 31 32 19. Vibratory compaction shall not be used in the compaction of base course in areas where geotextile fabrics are used.

3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- D. No fill shall be placed under water or over unsuitable subgrade conditions.
- E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
 - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
 - 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- F. No frozen material shall be placed nor shall any material be placed on frozen ground.

- G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.08 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.09 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, flowable fill shall be used as fill material.

3.10 PLACING GRANULAR CUSHION AND VAPOR BARRIER

- A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place the vapor barrier and granular cushion.
- B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on Drawings.

3.11 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

- A. The same day that the subgrade is exposed, place geotextile fabric on subgrade, and place 12 inches of crushed stone mat below tank slabs, manholes, vault slabs, and basement floors. Compact in place.
- B. Geotechnical fabric shall extend up the side edge of the stone mat and extend across the top of the stone to a minimum of 12 inches past the edge of base slab.

3.12 PIPE BEDDING AND COVER

- A. Immediately prior to placing the pipe, the trench bottom shall be shaped by hand to fit the entire bottom quadrant of the pipe. If pipe is of the bell and spigot type; bell holes shall be provided to prevent the bell from supporting the backfill load. Bell holes shall be large enough to permit proper making of the joint, but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding material under the body of the pipe. Any fill used must be bedding material. If necessary to obtain uniform contact of the pipe with the subgrade, a template shall be used to shape the bedding material. All pipe shall be placed on bedding material at least 4 inches thick. Bedding material shall then be placed and tamped into place up alongside the pipe in maximum 6-inch layers shovel slicing the bedding material under the haunches to provide firm contact with the pipe.

CONTRACTOR shall perform all necessary excavation and shall furnish all necessary material to provide this bedding.

- B. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise,

3.13 TRENCH BACKFILL CONSOLIDATION

- A. All trenches shall be consolidated as specified in this section for the entire depth and width of the trench.
- B. Consolidation shall be achieved by use of smooth surface vibratory compactors or backhoe operated hydraulic compactors for granular materials and rotating sheepsfoot type mechanisms for loam/clay soils. The lift height shall not exceed 8 inches for walk behind, hand operated, vibratory compactors and sheepsfoot. Lift height shall not exceed 24 inches for self-propelled vibratory drum or backhoe operated hydraulic compactors. Smaller lift heights shall be provided as necessary to achieve the degree of compaction specified.
- C. Unless specified otherwise, backfill material beneath paved areas or future paved areas and within 5 feet of paved areas or future paved areas shall be consolidated as follows: Within 3 feet of the surface 95% of maximum dry density, below 3 feet from the surface to 1 foot above the pipe 90% of maximum dry density, as determined by the modified Proctor Test (ASTM D1557).
- D. Unless otherwise specified, backfill material placed in all other areas shall be compacted to the point where no additional consolidation can be observed from the compaction and backfill equipment being used.
- E. Backfill material not meeting the compaction specification shall be recompacted by CONTRACTOR at no cost to OWNER. Cost for additional testing on recompacted material shall be at CONTRACTOR's expense.

3.14 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the drawings.
- B. Grading Tolerances:
 - 1. Rough Grade: Buildings, parking areas, and sidewalks— ± 0.1 feet.
 - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— ± 0.03 feet.
 - 3. Lawn areas away from buildings, parking areas, and sidewalks— ± 0.25 feet.

3.15 MAINTENANCE OF SURFACE

- A. CONTRACTOR shall maintain all backfilling, resurfacing, repaving, and other surface improvements constructed under this Contract. CONTRACTOR shall, upon proper notice from OWNER, make all repairs in surfaces of trenches and excavations. All expenses incurred by OWNER and/or CONTRACTOR in making repairs and all expenses in maintaining trench and excavation surfaces shall be at the expense of CONTRACTOR

regardless of the material used in backfilling trench excavations. OWNER reserves the right to make all emergency repairs necessary to make safe all streets and walks at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. A maintenance guarantee fund, if specified, will be withheld from the final amount due CONTRACTOR for a period of 6 months, after acceptance of the Work, to provide such maintenance.

- B. CONTRACTOR shall be responsible for controlling dust dispersion during utility and street construction. Remedial actions required as a result of inadequate dust control shall be CONTRACTOR's responsibility. To control dust, CONTRACTOR shall apply calcium chloride or ammonium lignin sulfonate in 12 to 14% solution or other dust control palliative acceptable to OWNER. Prior to application of dust palliative, the street shall be graded smooth.

3.16 COMPACTION TESTING

- A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

3.17 EXCAVATED SOLID WASTE FILL MATERIALS TO BE LANDFILLED

- A. If any solid waste fill materials are encountered, they shall be excavated and removed to a licensed sanitary landfill. Solid waste fill material is defined as any construction or demolition debris, household refuse, glass, metal, plastic, or similar material not native to the site, but having been placed on-site during past filling operations and mixed with soil. Allowance as specified shall apply.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Removal of groundwater to allow below grade construction.
 - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
 - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
 - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.
 - 3. Any permits necessary for the dewatering operations shall be obtained and paid for by CONTRACTOR.

1.02 REFERENCES

- A. See Division 01, Regulatory Requirements for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Wherever necessary, CONTRACTOR shall excavate in advance of the completed work, lead the water into sumps or pump wells, and provide erosion control measures to prevent water or sediment damage.
- C. CONTRACTOR's dewatering system shall perform so that the soils within the trench will not be destabilized by hydrostatic uplift pressures from adjacent groundwater. If conditions warrant, CONTRACTOR shall furnish and install well point systems or deep wells.
- D. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.

- E. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- F. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of “quick” conditions or “boils” shall be prevented.
- G. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- D. CONTRACTOR shall meet all requirements of applicable ODNR dewatering regulations.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
- B. Prior to dewatering, CONTRACTOR shall take into account the effect of its proposed dewatering operation on existing private water supply systems and shall make arrangements with property owners for protecting their supplies or providing alternative means of supply.
- C. In the event that CONTRACTOR's dewatering operation adversely affects private water supply systems, CONTRACTOR shall provide property owners with alternative potable and nonpotable supplies until dewatering operations are ceased and groundwater levels return to normal. If the water in private water supply wells is contaminated, through no fault of CONTRACTOR, after restoration of original groundwater levels, OWNER will provide measures to restore water potability. CONTRACTOR is responsible for restoration of the water supply, not its potability after restoration.
- D. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 31 25 00

SLOPE PROTECTION AND EROSION CONTROL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Erosion control devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 PAYMENT

- A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

1.03 REFERENCES

- A. ODOT Specifications in the Standard Specifications shall refer to the State of Ohio Department of Transportation, Construction and Material Specifications, 2010 edition.
- B. Conservation Practice Standards in the Standard Specifications shall refer to Ohio Department of Natural Resources, Division of Soil and Water Conservation, Rainwater and Land Development, current edition.
- C. Warren County Soil and Water Conservation District Construction Site Runoff Control, Erosion and Sediment Control Plan.

1.04 REGULATORY REQUIREMENTS

- A. Land disturbance greater than one acre and CONTRACTOR obtains NOI.
 - 1. Unless otherwise specified, for land disturbance activities exceeding 1 acre, develop and implement a Storm Water Erosion and Pollution Control Plan in accordance with conditions of federal and state permits, local ordinances, Best Management Practices, and as required by the Notice of Intent (NOI).
 - 2. The following certification shall be included in the Storm Water Erosion and Pollution Control Plan, which CONTRACTOR and all subcontractors shall sign:

"I certified under penalty of law that I understand the terms and conditions of the General Pollutant Discharge Elimination System (NPDES) Permit that authorizes the storm water discharges associated with industrial activities from the construction site above mentioned and as may be detailed in the construction documents. I agree to indemnify and hold OWNER harmless from any claims,

demands, suits causes of action, settlements, fines, or judgments and the costs of litigation, including, but not limited to, reasonable attorneys fees and costs of investigation and arising from a condition, obligation or requirement assumed or to be performed by CONTRACTOR for storm water pollution and erosion control.”

3. Where land disturbances exceed one acre, CONTRACTOR shall execute an NOI and send to OWNER and the appropriate OEPA office for the issuance of an NPDES Permit. CONTRACTOR shall also be responsible for all permit fees.
4. Such controls as identified in the Storm Water Erosion and Pollution Control Plan shall be installed prior to disturbing any soil on the site. CONTRACTOR shall construct, maintain, and remove the erosion and pollution controls in accordance with the plan within the criteria herein. Inspector who will monitor erosion and sediment control facilities shall be identified in the erosion and pollution control plan.
5. CONTRACTOR shall pay any fines or other fees resulting from failure of CONTRACTOR to comply with the permit requirements or failure to provide a permit.
6. CONTRACTOR shall submit a “Notice of Termination” (NOT) to OEPA within 45 days of reaching final stabilization.

B. CONTRACTOR and its subcontractors shall execute and sign the following certification:

“I certify under penalty of law that I understand the terms and conditions of the General Pollutant Discharge Elimination System Permit that authorizes the storm water discharges associated with industrial activities from the construction site and as may be detailed in the Contract Documents. I agree to indemnify and hold OWNER harmless from any claims, demands, suits, causes of action, settlements, fines, or judgments and the costs of litigation, including, but not limited to, reasonable attorneys fees and costs of investigation and arising from a condition, obligation or requirement assumed or to be performed by CONTRACTOR for storm water pollution and erosion control.”

C. CONTRACTOR shall pay any fines or other fees resulting from failure of CONTRACTOR to comply with the permit requirements.

1.05 QUALITY CONTROL

- A. Construct and maintain erosion sediment control measures in accordance with the Conservation Practice Standards.
- B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

PART 2–PRODUCTS

2.01 EROSION MATS

- A. Erosion mat products shall be in conformance with criteria specified in Conservation Practice Standard Chapter 7, Section 7.12-Temporary Rolled Erosion Control Products (Erosion Control Matting).
- B. Unless designated on the drawings, CONTRACTOR may furnish any prequalified erosion mat product of the class and type listed in the Conservation Practice Standards.

- C. A 300 mm by 300 mm sample of a product proposed for erosion mat may be required to verify that it is prequalified. When a sample is required, it shall be accompanied by the manufacturer's literature for the proposed product.

2.02 SILT FENCE

- A. Silt fence shall conform to Conservation Practice Standards Chapter 6, Section 6.3-Silt Fence.
- B. Furnish wrapping on each roll of fabric to protect the fabric from ultraviolet radiation and from abrasion during shipping and handling. Keep geotextile dry until installed.

2.03 SOIL STABILIZER

- A. Soil stabilizer shall be Type A. Type A is either a cementitious soil binder added to wood cellulose fiber mulch or a bonded fiber matrix.

2.04 INLET PROTECTION

- A. Inlet protection shall conform to Conservation Practice Standards Chapter 6, Section 6.4-Storm Drain.

2.05 CONSTRUCTION ENTRANCES AND TIRE WASHING STATION

- A. Construction entrances and tire washing stations shall conform to Conservation Practice Standards Chapter 7, Section 7.4-Construction Entrance.

2.06 DITCH CHECKS

- A. Ditch checks shall conform to ODOT CMS Item 207.

2.07 MULCHING

- A. Mulching for construction sites shall conform to Conservation Standards Chapter 7, Section 7.9-Mulching.

2.08 TEMPORARY SEEDING

- A. Temporary seeding for construction site erosion control shall conform to Conservation Standards Chapter 7, Section 7.8-Temporary Seeding.

2.09 TRENCH DAM

- A. Where shown on the Drawings or requested by ENGINEER in the field, CONTRACTOR shall install clay trench dams to prevent groundwater from flowing continuously through the bedding material installed for the sanitary sewer. Trench dams shall be 4 feet long and shall extend from the bottom of the trench excavation to within 2 feet of the ground surface and 1 foot beyond the normal trench width on both sides of the trench.

PART 3-EXECUTION

3.01 GENERAL

- A. Install devices before construction activities begin.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).
- C. Unless noted on drawings, do not remove trees and surface vegetation.
- D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.
- E. CONTRACTOR shall provide a "qualified" inspector to inspect erosion control and sediment controls once in place. Inspector shall have prior experience with and knowledge of installation and maintenance of erosion and pollution controls. Unless stricter requirements are mandated by ODNR or by any local permits, project site erosion control inspection shall be conducted every seven days and after each one-half-inch rainfall or greater. CONTRACTOR shall maintain hard copies of the inspection reports for the duration of the Project.
- F. Any necessary repairs to erosion and sediment control facilities shall be provided within 24 hours to all corrective measures noted on the inspection reports to address pollution issues. CONTRACTOR shall submit to OWNER a written notice stating the times, dates and actions taken to rectify the defective erosion and sediment controls.
- G. CONTRACTOR shall also make any necessary additions for erosion and sediment control as may result from on-site conditions or the progress of the Work or as may be required by ODNR or OWNER.
- H. Disturbed areas shall be stabilized with temporary or permanent measures within 14 calendar days of the soil disturbance or redisturbance.
- I. All temporary erosion and sediment control measures shall be removed within 30 days after final stabilization is achieved or after the temporary measures are no longer needed. All sediment accumulated in temporary and permanent facilities shall be removed and properly disposed of and the area restored.

3.02 EROSION MAT

- A. Erosion mats shall be installed in accordance with manufacturer's requirements and with Conservation Practices Standards Chapter 7, Section 7.12-Temporary Rolled Erosion Control Products (Erosion Control Matting).
- B. Place erosion mats immediately after seeding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all organic material or other foreign material which may interfere with the mat bearing completely on the soil.

- C. Any small stones or clods which prevent contact of the mat with the soil shall be pressed in the soil with a small lawn-type roller or by other means. The mat shall have its lateral edge so impressed in the soil so as to permit runoff water to flow over it.
- D. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly and smoothly in a natural position without stretching and with all parts bearing on soil. Place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with upgrade section on top.
- E. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the imbedded fabric or blanket.
- F. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples on 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.
- G. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.
- H. Dispose of surplus excavated materials during erosion mat placing operation as specified for original seeding.
- I. Following mat placement, uniformly apply water to the area to moisten seed bed to 2-inch depth and in a manner to avoid erosion.
- J. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires, or other causes until Work is accepted.

3.03 SILT FENCE

- A. Silt fence shall be constructed in conformance with the criteria specified in Conservation Practice Standards Chapter 6, Section 6.3-Silt Fence.

3.04 SOIL STABILIZER

- A. Soil stabilizers that are a cementitious soil binder added to wood cellulose fiber mulch or a bonded fiber matrix shall be applied with conventional hydraulic seeding equipment. CONTRACTOR shall take care so that surrounding surfaces, structures, trees, and shrubs are not over-sprayed. Before work is accepted any over-spray must be satisfactorily cleaned from surfaces. The finished application shall be 3/16 inches to 1/4 inch thick. For permanent slope applications, CONTRACTOR shall sow seed separately before applying the soil stabilizer so the seed has direct contact with the soil.
- B. Soil stabilizers shall be US Gypsum Company Airtrol Plaster for Wood Mulch, Mat, Inc. Soil Guard, or North American Green Hydra CX-2.

3.05 INLET PROTECTION

- A. All storm drains that are or will be functioning during construction shall be provided with inlet protection. Inlet protection shall be provided in conformance with the criteria specified in Conservation Practice Standards Chapter 6, Section 6.4-Storm Drain Inlet Protection.

3.06 CONSTRUCTION ENTRANCES

- A. Construction entrances (tire washing stations as required) shall be installed in accordance with the criteria in Conservation Practice Standards Chapter 7, Section 7.4-Construction Entrances.
- B. Surface water must be prevented from passing through construction entrances. Flows shall be diverted away from construction entrances and conveyed under and around them such as with culverts.
- C. Any sediment tracked onto a road shall be removed before the end of each day. Flushing sediment shall not be allowed.

3.07 DITCH CHECKS

- A. Ditch checks shall be provided in conformance with the criteria specified in ODOT CMS Item 207.

3.08 MULCHING

- A. Mulching shall be provided in conformance with the criteria specified in Conservation Practice Standards Chapter 7, Section 7.9-Mulching.

3.09 TEMPORARY SEEDING

- A. Temporary seeding for erosion control shall be provided in conformance with the criteria specified in Conservation Practice Standards Chapter 7, Section 7.8-Temporary Seeding.

3.10 SEDIMENT TRAPS AND SEDIMENT BASINS

- A. Sediment traps for erosion and sedimentation control during interim construction stages shall be installed in accordance with the criteria in Conservation Practice Standards Chapter 6, Section 6.2-Sediment Trap and sediment basins with the criteria in Chapter 6, Section 6.1-Sediment Basin. They shall be constructed prior to any disturbances and shall be placed so they function during all phases of the Work.

END OF SECTION

SECTION 31 32 19

GEOTEXTILES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Geotextiles for areas below structures, at perforated drain pipe trenches, pressure relief valves, below base course, and below riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Geotextile for areas below structures for use at perforated drain pipe trenches and pressure relief valves and as specified elsewhere, shall be Mirafi 140N, or equal.
- B. Geotextile below riprap shall be Mirafi 180N, or equal.
- C. Geotextile below base course shall be Mirafi 500X, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Geotextile shall be installed in accordance with manufacturer's recommendations.
- B. Geotextile shall be lapped a minimum of 24 inches.
- C. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Furnishing and placing riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Ohio Department of Transportation, Construction and Material Specifications, current edition, including all issued supplemental specifications.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.
- B. Stone for riprap shall be in accordance with Standard Specifications, Item 601.04.A Riprap as herein modified.

PART 3–EXECUTION

3.01 PREPARATION

- A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick.
- B. Geotextile shall be placed below riprap. See Section 31 32 19–Geotextile.

3.02 INSTALLATION

- A. Riprap shall be provided in areas as designated on the drawings and in accordance with the Drawings.
- B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact.

- C. The riprap shall be thoroughly compacted as construction progresses, and the finished surface shall present an even, tight surface.
- D. The large stone shall be placed in the lower courses. Interstices between stones shall be chinked with spalls firmly rammed into place.
- E. Unless otherwise shown or specified, riprap shall be at least 18 inches in thickness, measured perpendicular to the slope.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aggregate base course for roads and parking areas.
 - 2. Gravel roads.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and gravel areas damaged in accordance with this section. All paved areas shall also be repaired in accordance with Section 32 11 26–Flexible Pavement.

1.02 MEASUREMENT AND PAYMENT

- A. Repair or replacement of aggregate base course shall be considered incidental and included in the price bid.

1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Ohio Department of Transportation, Construction and Material Specifications, 2019 edition, including all issued supplemental specifications.

1.04 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.05 SUBMITTALS

- A. Submit sieve analysis for proposed materials in accordance with Section 01 33 00–Submittals.

1.06 DRAINAGE DURING CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of the Stormwater Pollution Prevention Plan and the current Construction Stormwater General Permit for the State of Ohio.

PART 2–PRODUCTS

2.01 AGGREGATES

- A. Aggregate for base course shall meet the requirements of Item 304 of the Standard Specifications.
- B. Base course shall be uniformly graded and shall conform to the requirements of Item 703.17 of the Standard Specifications.
- C. Material for top layer of shoulders shall meet the requirements of Item 411, stabilized crushed aggregate, of the Standard Specifications.

PART 3–EXECUTION

3.01 PREPARATION

- A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded tri-axle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Item 204 of the Standard Specifications.

3.02 CONSTRUCTION

- A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.
- B. Depth of base course shall be provided according to the standard cross sections or details provided on the drawings.
- C. Depth of base course shall be the existing depth or 9 inches, whichever is greater.
- D. Base course shall be placed directly on subgrade areas or on top of salvaged asphalt millings unless otherwise indicated on Drawings.
- E. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with Item 304 of the Standard Specifications.
- F. The finished base course shall be fine graded in preparation for paving.
- G. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.
- H. All gravel surfaces damaged during construction shall be replaced with aggregate materials and sizes matching existing. The depth of aggregate shall match existing or 8 inches, whichever is greater.

END OF SECTION

SECTION 32 11 26

FLEXIBLE PAVEMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes asphalt concrete paving, tack coat, and casting adjustments.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall replace all roads, shoulders, and paved areas damaged during the project in accordance with this section. Gravel shoulders, gravel roads, and parking areas shall be repaired in accordance with Section 32 11 23–Aggregate Base Course.

1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for flexible pavement shall be considered incidental to the project and included in the Lump Sum Bid.

1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Ohio Department of Transportation, Construction and Material, 2019 edition, including all issued supplemental specifications.

1.04 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.05 SUBMITTALS

- A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 FLEXIBLE PAVEMENT

- A. Asphaltic material shall meet requirements of ODOT Item 301 for base course and requirements for mixtures of ODOT Item 401 and 448 for intermediate and surface course. These mixtures shall have been approved on a recent ODOT project.
- B. Aggregate shall conform to the requirements of Items 703.04 and 703.05 of the Standard Specifications.

- C. Where existing pavement is replaced, minimum pavement thickness shall be 4 inches or existing thickness, whichever is greater. Intermediate course shall be 2 1/4 inches minimum. Surface course shall be 1 1/2 inches minimum. Intermediate course shall be asphalt concrete intermediate course, type 2 (448). Surface course shall be asphalt concrete surface course, type 1 (448), P6 64-22.
- D. Materials for prime and tack coats shall conform to Items 407 and 408 requirements of the Standard Specifications.

PART 3–EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

- A. CONTRACTOR shall remove asphalt pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.
- B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

3.02 CASTING ADJUSTMENTS

- A. All new and existing manhole castings and valve boxes within the paving limits of the street, which require adjustment, shall be adjusted to match the finished asphaltic surface. Adjustments shall not be made greater than 48 hours prior to the anticipated time of paving. Adjustments shall be performed as called for in Section 33 00 10–Buried Piping and Appurtenances. CONTRACTOR shall furnish Class 1 barricades with flashers on all adjusted castings until paving has been completed. Tops of castings and valve boxes shall be oiled or protected by other methods to prevent sealing of lids and filling of lift holes during paving. Upon completion of paving operations, CONTRACTOR shall check all castings and valve boxes to see that the lids are clean and operational. Manhole casting adjustment shall be included in the cost of other items of work, and no further compensation will be made. Valve box adjustment shall be considered an incidental item of work.

3.03 TACK COAT

- A. All work shall be in accordance with Item 407 of Standard Specifications.
- B. If asphaltic surface course is applied to an existing street or is not applied the same day as intermediate course, the existing street or intermediate surface shall be tack coated prior to surface paving. Prior to placement of tack coat, the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.10 gallons per square yard immediately prior to placement of asphaltic surface course.
- C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

- D. Aggregate bases shall have a layer of prime coat applied prior to paving the intermediate course. The prime coat shall be applied at the rate of 0.25 to 0.50 gallons per square yard.

3.04 JOINTS

- A. Joints between old and new pavements or between successive day's work shall be constructed and treated as to provide a thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. All cold transverse joints shall be treated with a certified 702.01 PG binder or 702.13 rubberized asphalt emulsion to provide 100% coverage. Material shall be applied with a hose and spray nozzle attachment to fully coat the joint surface.
- B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the surface course shall at no time be placed immediately over similar joints in the binder course beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the binder course and the location of similar joints in the surface course above. All longitudinal cold joints shall be treated with a certified 702.01 PG binder or 702.13 rubberized asphalt emulsion to provide 100% coverage.
- C. All costs for furnishing and applying binder to butt joints as specified above shall be considered incidental.

3.05 FINISHING ROADWAY

- A. The finished base course shall be fine-graded in preparation for flexible paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.
- B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing binder course to receive surface course shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive binder course only.
- C. Finishing roadway shall be considered incidental to flexible paving.
- D. Paint all markings as shown on Drawings with lines not less than 4 inches wide.

3.06 TESTING

- A. ENGINEER may require samples of flexible pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

3.07 PAVING

- A. Flexible paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on Drawings. All work shall be performed in accordance with Item 401 of the Standard Specifications.
- B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.
- C. The pavement structure for streets, roads, driveways, and paths shall be determined from the standard cross sections provided on Drawings.

3.08 PAVEMENT PLANNING

- A. Pavement planning shall be to the depth and at the locations shown on the drawings. Pavement planning shall be in accordance with Item 254 of the Standard Specifications.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER, SIDEWALKS, DRIVEWAYS, AND DRIVEWAY APRONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes concrete curb and gutter, sidewalks, driveways, and driveway aprons as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 MEASUREMENT AND PAYMENT

- A. All costs of the Work shall be included in the Lump Sum Bid.

1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.
- B. AASHTO M148 Standard Specifications for Liquid Membrane–Forming Compounds for Curing Concrete.

1.04 QUALITY ASSURANCE

- A. Unless otherwise specified, all curb and gutter, sidewalks, driveway, and driveway apron construction shall meet the requirements of the Standard Specifications.

1.05 QUALITY MANAGEMENT PROGRAM

- A. For concrete curb and gutter, sidewalks, driveways, and driveway aprons, CONTRACTOR shall comply with the provisions of Section 716 of the Standard Specifications for Class II concrete.
- B. For concrete pavement, CONTRACTOR shall comply with the provisions of Section 715 of the Standard Specifications for Class I concrete.

PART 2–PRODUCTS

2.01 CONCRETE

- A. All concrete shall be Class A or A-FA as specified in Section 03 30 00–Cast-in-Place Concrete.

2.02 CURING COMPOUND

- A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, White Pigmented.

PART 3—EXECUTION

3.01 BASE PREPARATION—CURB AND GUTTER

- A. The dense graded base beneath the curb and gutter shall be trimmed or filled as necessary to provide a full depth of curb and gutter as detailed. In the absence of a detail, the dense graded base depth shall be to the adjacent street subgrade with a minimum of 4 inches. Prior to placement of concrete, the dense graded base shall be thoroughly compacted and moistened.

3.02 BASE PREPARATION—SIDEWALKS AND DRIVEWAYS

- A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.

3.03 BASE COURSE

- A. Base course beneath curb and gutter, sidewalks, and driveways shall comply with Section 32 11 23.

3.04 FORMS

- A. Forms shall be of metal and of sufficient strength to resist distortion or displacement. Metal forms shall be used to construct a curb and gutter cross section as shown on the Drawings. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the drawings. Forms shall be securely staked and held firmly to line and grade. Forms shall be cleaned thoroughly and oiled before reuse. Where machines are used, concrete mixture shall be controlled to prevent distortion from sloughing.
- B. All curved curb and gutter shall form smooth curves and shall not be a series of chords. Radius forms shall be used for all curved curb and gutter where the radius of curvature is 100 linear feet or less.

3.05 PLACING AND FINISHING CONCRETE

- A. Unless otherwise specified, concrete shall be placed in accordance with Section 03 30 00—Cast-in-Place Concrete.
- B. Concrete shall be thoroughly vibrated to remove all voids. The exposed surface shall be thoroughly troweled and finished with a brush at right angles to vehicular or pedestrian traffic. All edges shall be rounded with a 1/4-inch-radius edger. Honeycombed areas shall be pointed and rubbed with mortar to provide a void-free surface.
- C. Before final finishing, a 10-foot straight edge shall be used to check the surface. Any areas showing a variation of more than 1/4 inch from the straight edge shall be corrected. Final

finishing shall be delayed a sufficient time so that excess water and grout will not be brought to the surface.

- D. Concrete for sidewalk shall be placed to a minimum thickness of 5 inches, except at driveways and alleys, which shall have a minimum thickness of 7 inches. Driveways, driveway aprons, and curb ramps shall have a minimum thickness of 7 inches. The concrete shall be thoroughly vibrated to remove all voids. The surface of the driveway or sidewalk shall be thoroughly troweled and finished with a brush at right angles to the driveways or sidewalk line.

3.06 MACHINE FORMED CURB AND GUTTER

- A. CONTRACTOR may elect to use a machine for placing, forming, and consolidating concrete curb and gutter. If a machine is used, the resulting curb and gutter shall be of such a quality as to equal or exceed that produced by the method described above.
- B. Curb and gutter where required for street construction, site Work construction, or for restoration of utility construction shall be placed using forms or a machine to the dimensions and shape shown. Where curb and gutter details are not provided, curb and gutter shape and dimensions shall match existing adjacent curb and gutter.

3.07 DRIVEWAY OPENINGS

- A. Driveway openings will be staked by CONTRACTOR in the field. The details for concrete gutter section through a driveway are shown on the Detail Drawings.

3.08 REJECT SECTIONS

- A. At locations shown on the drawings, the curb and gutter shall be warped so as to reject the flow of water. The transition from a standard section to a reject section shall not be abrupt but shall be a minimum of 10 feet in length. The reject section shall conform to the Detail Drawings.

3.09 JOINTING—CURB AND GUTTER

- A. A 1/2-inch expansion joint filler shall be placed through the curb and gutter at the radius points of all intersection curbs at storm inlets and at a maximum interval of 100 feet. This expansion joint filler shall extend through the entire thickness of concrete and shall be perpendicular to the surface and at right angles to the line of the curb and gutter.
- B. At intervals of not more than 10 feet, a contraction joint shall be tooled to a depth of one-fifth of the total concrete thickness with a 1/4-inch-radius jointer. The contraction joint shall be at right angles to the line of the curb and gutter.
- C. If machine-formed curb and gutter is provided by CONTRACTOR, CONTRACTOR shall create a plane of weakness at all joints that is sufficient to cause contraction cracking at the joints.
- D. CONTRACTOR may saw contraction joints. The depth of cut shall be a minimum of one-fifth of the total concrete thickness. Sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage

cracking takes place in the concrete. If this method results in random cracking, CONTRACTOR will be required to tool the contraction joints as specified above.

- E. Steel separator plates of a section conforming to the curb and gutter as shown on the drawings shall be placed directly opposite all contraction joints in abutting street pavement. After separator plates have been removed, the edges of the joints shall be rounded with a 1/4-inch radius edge. The use of steel separator plates at other locations will not be allowed.
- F. Jointing shall be included in the price bid for curb and gutter.

3.10 JOINTING--SIDEWALKS AND DRIVEWAYS

- A. Concrete sidewalk shall be segmented into 5-foot-long rectangular blocks with tooled joints. Concrete driveways shall be segmented into uniform rectangular blocks with tooled joints at a maximum spacing of 10 feet in each direction. The joint must extend at least one-fifth of the total thickness of concrete. The edges of the sidewalk along forms and joints shall be rounded with an edging tool of 1/4-inch radius. All joints shall be at right angles to the centerline of the sidewalk.
- B. Concrete driveways shall be jointed in approximately square sections. The depth of the joint and the finishing of the edges shall be the same as for concrete sidewalk.

3.11 EXPANSION JOINTS

- A. A 1/2-inch-thick asphaltic expansion joint filler shall be placed at sidewalk-driveway intersections, between sidewalks and buildings, between back of curb and sidewalk, at intersection between new or existing curb and gutter, around all castings, and at maximum 40-foot intervals in sidewalks.

3.12 SLOPE

- A. Sidewalk cross slope shall be 1.5 percent unless otherwise noted in the drawings or requested by ENGINEER.

3.13 CURB RAMP

- A. Curb ramps shall have a maximum slope of 7 percent, with maximum grade changes of 11 percent at curb to ramp transitions, and be provided with a truncated dome patterned surface meeting ADA requirements.

3.14 INLET CASTING ADJUSTMENT

- A. Inlet casting shall be adjusted to grade as required for the installation of the new curb and gutter. Inlet casting backs shall be adjusted for a depressed flow line at all inlets in the low points (0.72 feet); all other inlet shall be adjusted for a normal flow line (0.50 feet).

3.15 CURING

- A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.

- B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.
- C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound applied at the same rate as on the finished surface.

3.16 PROTECTION OF CONCRETE

- A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at his own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.
- B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.
- C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over newly placed concrete until a minimum compressive strength of 3,000 psi has been achieved.

END OF SECTION

SECTION 32 32 16

PRECAST MODULAR BLOCK RETAINING WALL

PART 1–GENERAL

1.01 SUMMARY

- A. This Section includes furnishing all materials and labor required for the design and construction of a precast concrete modular block (PMB) retaining wall with or without geosynthetic reinforcement. Precast modular block retaining wall blocks under this section shall be cast utilizing a wet-cast concrete mix and exhibit a final handling weight in excess of 1,000 pounds per unit and may utilize concrete-reinforcing steel.
- B. Scope of Work: The work shall consist of furnishing materials, labor, equipment and supervision for the construction of a precast modular block (PMB) retaining wall structure in accordance with the requirements of this section and in acceptable conformity with the lines, grades, design and dimensions shown in the project site plans.
- C. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 31, Division 32 and Division 33 also apply to this Section.

1.02 REFERENCES

- A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document
- B. Reference Standards:
 - 1. Design:
 - a. AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014.
 - b. Minimum Design Loads for Buildings and Other Structures – ASCE/SEI 7-10.
 - c. International Building Code, 2018 Edition.
 - d. FHWA-NHI-10-024 Volume I and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
 - e. FHWA-NHI-10-025 Volume II and GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes.
 - f. National Concrete Masonry Association (NCMA) Design Manual for Segmental Retaining Walls (ASD), 3rd Edition
 - 2. Precast Modular Block Units:
 - a. ACI 201– Guide to Durable Concrete
 - b. ACI 318–Building Code Requirements for Structural Concrete
 - c. ASTM A615–Steel Bars for Concrete Reinforcement
 - d. ASTM A767–Galvanized Steel Bars for Concrete Reinforcement
 - e. ASTM A775–Epoxy-Coated Steel Reinforcing Bars
 - f. ASTM C33–Standard Specification for Concrete Aggregates
 - g. ASTM C39–Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - h. ASTM C94–Standard Specification for Ready-Mixed Concrete.
 - i. ASTM C136–Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - j. ASTM C143–Standard Test Method for Slump of Hydraulic-Cement Concrete.

- k. ASTM C150–Standard Specification for Portland Cement
 - l. ASTM C231–Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - m. ASTM C260–Standard Specification for Air-Entraining Admixtures for Concrete.
 - n. ASTM C494–Standard Specification for Chemical Admixtures for Concrete.
 - o. ASTM C595–Standard Specification for Blended Hydraulic Cements.
 - p. ASTM C618–Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - q. ASTM C666–Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
 - r. ASTM C845–Standard Specification for Expansive Hydraulic Cement.
 - s. ASTM C920–Standard Specification for Elastomeric Joint Sealants.
 - t. ASTM C989–Standard Specification for Slag Cement for Use in Concrete and Mortars.
 - u. ASTM C1116–Standard Specification for Fiber-Reinforced Concrete.
 - v. ASTM C1157–Standard Performance Specification for Hydraulic Cement.
 - w. ASTM C1218–Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
 - x. ASTM C1240–Standard Specification for Silica Fume Used in Cementitious Mixtures.
 - y. ASTM C1611–Standard Test Method for Slump Flow of Self-Consolidating Concrete.
 - z. ASTM C1776–Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.
 - aa. ASTM D6638–Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
 - bb. ASTM D6916–Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).
3. Geosynthetics:
- a. AASHTO M 288– Geotextile Specification for Highway Applications.
 - b. ASTM D3786–Standard Test Method for Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method.
 - c. ASTM D4354–Standard Practice for Sampling of Geosynthetics for Testing.
 - d. ASTM D4355–Standard Test Method for Deterioration of Geotextiles
 - e. ASTM D4491–Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - f. ASTM D4533–Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - g. ASTM D4595–Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - h. ASTM D4632–Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - i. ASTM D4751–Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - j. ASTM D4759–Standard Practice for Determining Specification Conformance of Geosynthetics.
 - k. ASTM D4833–Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - l. ASTM D4873–Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
 - m. ASTM D5262–Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics.

- n. ASTM D5321–Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
 - o. ASTM D5818–Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.
 - p. ASTM D6241–Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
 - q. ASTM D6637–Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
 - r. ASTM D6706–Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.
 - s. ASTM D6992–Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.
4. Soils:
- a. AASHTO M 145– AASHTO Soil Classification System.
 - b. AASHTO T 104–Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
 - c. AASHTO T 267–Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.
 - d. ASTM C33–Standard Specification for Concrete Aggregates.
 - e. ASTM D448–Standard Classification for Sizes of Aggregates for Road and Bridge Construction.
 - f. ASTM D698–Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft (2,700 kN-m/m)).
 - g. ASTM D1241–Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.
 - h. ASTM D1556–Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
 - i. ASTM D1557–Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft (2,700 kN-m/m)).
 - j. ASTM D2487–Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - k. ASTM D2488–Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
 - l. ASTM D3080–Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.
 - m. ASTM D4254–Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - n. ASTM D4318–Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - o. ASTM D4767–Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.
 - p. ASTM D4972–Standard Test Method for pH of Soils.
 - q. ASTM D6913–Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
 - r. ASTM D6938–Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).
 - s. ASTM G51–Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.
 - t. ASTM G57–Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

5. Drainage Pipe:
 - a. ASTM D3034—Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - b. ASTM F2648—Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preconstruction Meeting. CONTRACTOR shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction. Participation in the preconstruction meeting shall be required of CONTRACTOR, Retaining Wall Design Engineer (RWDE), Retaining Wall Installation Contractor (RWIC), Grading Contractor, and Inspection Engineer. CONTRACTOR shall provide notification to all parties at least 10 calendar days prior to the meeting. Preconstruction Meeting Agenda:
 1. The RWDE shall explain all aspects of the retaining wall construction drawings.
 2. The RWDE shall explain the required bearing capacity of soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Inspection Engineer.
 3. The RWDE shall explain the required shear strength of fill soil in the reinforced, retained and foundation zones of the retaining wall to the Inspection Engineer.
 4. The RWDE shall explain any measures required for coordination of the installation of utilities or other obstructions in the reinforced or retained fill zones of the retaining wall.
 5. The RWIC shall explain all excavation needs, site access and material staging area requirements to the CONTRACTOR and Grading Contractor.

1.04 SUBMITTALS

- A. Product Data. At least 14 days prior to construction, CONTRACTOR shall submit the retaining wall product submittal package to the Owner's Representative for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:
 1. Precast Modular Block System brochure
 2. Precast Modular Block concrete test results specified in paragraph 2.01, subparagraph B of this section as follows:
 - a. 28-day compressive strength.
 - b. Air content.
 - c. Slump or Slump Flow (as applicable).
 3. Drainage Pipe.
 4. Geotextile.
 5. Geosynthetic Soil Reinforcement (if required by the retaining wall design). The contractor shall provide certified manufacturer test reports for the geosynthetic soil reinforcement material in the manufactured roll width specified. The test report shall list the individual roll numbers for which the certified material properties are valid.
- B. Installer Qualification Data. At least 14 days prior to construction, CONTRACTOR shall submit the qualifications of the business entity responsible for installation of the retaining wall, the RWIC, per paragraph 1.07, subparagraph A of this section.
- C. Retaining Wall Design Calculations and Construction Shop Drawings. At least 14 days prior to construction, CONTRACTOR shall furnish electronic versions construction shop drawings

and the supporting structural calculations report to the Owner for review and approval. This submittal shall include the following:

1. Signed, sealed and dated drawings and engineering calculations prepared in accordance with these specifications.
2. Qualifications Statement by the RWDE summarizing their Experience.
3. Certificate of Insurance of the RWDE as specified in paragraph 1.06, subparagraph B of this section.

1.05 WARRANTY

- A. The RWDE shall coordinate the retaining wall construction shop drawing preparation with the project Civil Engineer, project Geotechnical Engineer and Owner's Representatives. CONTRACTOR shall furnish the RWDE the following project information required to prepare the construction shop drawings. This information shall include, but is not limited to, the following:
 1. Current versions of the site, grading, drainage, utility, erosion control, landscape, and irrigation plans;
 2. electronic CAD file of the civil site plans listed in (1);
 3. report of geotechnical investigation and all addenda and any supplemental reports;
 4. recommendations of the project Geotechnical Engineer regarding effective stress shear strength and total stress shear strength (when applicable) parameters for in-situ soils in the vicinity of the proposed retaining wall(s) and for any fill soil that may potentially be used as backfill in retained and/or foundation zones of the retaining wall.
- B. The RWDE shall provide the Owner with a certificate of professional liability insurance verifying the minimum coverage limits of \$1 million per claim and \$1 million aggregate.
- C. Design of the precast modular block retaining wall shall satisfy the requirements of this section. Where local, State, or national design or building code requirements exceed these specifications, these requirements shall also be satisfied.
- D. The RWDE shall note any exceptions to the requirements of this section by listing them at the bottom right corner of the first page of the construction shop drawings.
- E. Approval or rejection of the exceptions taken by the Retaining Wall Design Engineer (RWDE) will be made in writing.
- F. The RWDE shall determine the appropriate standard(s) to be utilized, and to which the precast modular block design shall be based upon, except as noted herein. Refer to Part 1.03, Paragraph C, Part 1.
- G. In the event that a conflict is discovered between these specifications and a reasonable interpretation of the design specifications and methods referenced in paragraph F above, these specifications shall prevail. If a reasonable interpretation is not possible, the conflict shall be resolved per the requirements in paragraph 1.03, subparagraph A of this section.
- H. Soil Shear Parameters. The RWDE shall prepare the construction shop drawings based upon soil shear strength parameters from the available project data and the recommendations of the project Geotechnical Engineer. If insufficient data exists to develop the retaining wall design, the RWDE shall communicate the specific deficiency of the project information or data to the Owner in writing.

- I. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.
- J. Global Stability. Overall (global) stability shall be evaluated in accordance with the principals of limit equilibrium analysis as set forth in FHWA-NHI-10-024 Volume I and FHWA-NHI-10-025 Volume II GEC 11 Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, or other methods, as determined by the RWDE, as referenced in Section 1.06, Part F. The minimum factors of safety shall be as follows:

Normal Service (Static)	1.3
Seismic	1.1
Rapid Drawdown (if applicable)	1.2

Note: RWDE to select appropriate FOS

- K. Seismic Stability. Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology, or NCMA (ASD) methodology as determined by the RWDE as referenced in Section 1.06, Part F.

1.06 MAINTENANCE

- A. RWIC Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the RWIC shall possess the following experience:
 1. Construction experience with a minimum of 3,000 square feet (280 square meters) of the proposed precast modular block retaining wall system.
 2. Construction of at least three (3) precast modular block (large block) retaining wall structures within the past three (3) years.
 3. Construction of at least 5,000 square feet (465 square meters) of precast modular block (large block) retaining walls within the past five (5) years.
- B. RWDE (RWDE) Qualifications and Statement of Experience. The RWDE shall submit a written statement affirming that he or she has the following minimum qualifications and experience.
 1. The RWDE shall be licensed to practice in the jurisdiction of the project location.
 2. The RWDE shall be independently capable of performing all internal and external stability analyses, including those for seismic loading, compound stability, rapid draw-down and deep-seated, global modes of failure.
 3. The RWDE shall affirm in writing that he or she has personally supervised the design of the retaining walls for the project, that the design considers all the requirements listed in paragraph 1.06 and that he or she accepts responsibility as the design engineer of record for the retaining walls constructed on the project.
 4. The RWDE shall affirm in writing that he or she has designed a minimum of approximately 3,000 face square feet (280 face square meters) of modular block earth retaining walls within the previous five years.
 5. In lieu of these specific requirements, the engineer may submit alternate documentation demonstrating competency in Precast Modular Block retaining wall design.
- C. OWNER reserves the right to reject the services of any RWDE or RWIC who, in the sole opinion of OWNER, does not possess the requisite experience or qualifications.

1.07 QUALITY CONTROL

- A. OWNER's Representative shall review all submittals for materials, design, RWDE qualifications and the RWIC qualifications.
- B. CONTRACTOR shall retain the services of an Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. The cost of inspection shall be the responsibility of CONTRACTOR. Inspection shall be continuous throughout the construction of the retaining walls.
- C. The Inspection Engineer shall perform the following duties:
 - 1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
 - 2. Verify that soil or aggregate fill placed and compacted in the reinforced, retained and foundation zones of the retaining wall conforms with paragraphs 2.04 and 2.05 of this section and exhibits the shear strength parameters specified by the RWDE.
 - 3. Verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate.
 - 4. Inspect and document soil compaction in accordance with these specifications:
 - a. Required dry unit weight
 - b. Actual dry unit weight
 - c. Allowable moisture content
 - d. Actual moisture content
 - e. Pass/fail assessment
 - f. Test location – wall station number
 - g. Test elevation
 - h. Distance of test location behind the wall face
 - 5. Verify that all excavated slopes in the vicinity of the retaining wall are bench-cut as required.
 - 6. Notify the RWIC of any deficiencies in the retaining wall construction and provide the RWIC a reasonable opportunity to correct the deficiency.
 - 7. Notify CONTRACTOR, OWNER and RWDE of any construction deficiencies that have not been corrected in a timely manner.
 - 8. Document all inspection results and provide reports to OWNER, RWDE, and RWIC.
 - 9. Test compacted density and moisture content of the retained backfill with the following frequency:
 - a. At least once every 500 square feet (45 square meters) (in plan) per vertical lift, and
 - b. At least once per every 18 inches (460 mm) of vertical wall construction.
- D. CONTRACTOR's engagement of the Inspection Engineer does not relieve the RWIC of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these specifications.
- E. The RWIC shall inspect the on-site grades and excavations prior to construction and notify the RWDE and CONTRACTOR if on-site conditions differ from the elevations, assumptions, and grading conditions depicted in the retaining wall construction shop drawings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The RWIC shall observe the materials upon delivery to verify that the proper type, grade and color of materials have been delivered.

- B. The RWIC shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work.
- C. Geosynthetics: All geosynthetic materials shall be handled in accordance with ASTM D4873. The materials should be stored off the ground and protected from precipitation, sunlight, dirt and physical damage.
- D. Precast Modular Blocks: Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three units high in the storage area.
- E. Drainage Aggregate and Backfill Stockpiles
 - 1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.
 - 2. Drainage aggregate and/or reinforced fill material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2–MATERIALS

2.01 PRECAST MODULAR BLOCK RETAINING WALL UNITS

- A. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.
- B. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three years or the total time the manufacturer has been licensed, whichever is less.
- C. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties as shown in the following table:

Concrete Mix Properties

Freeze Thaw Exposure Class ⁽¹⁾	Minimum 28-Day Compressive Strength ⁽²⁾	Maximum Water Cement Ratio	Nominal Maximum Aggregate Size	Aggregate Class Designation ⁽³⁾	Air Content ⁽⁴⁾
Moderate	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3M	4.5% +/- 1.5%
Severe	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3S	6.0% +/- 1.5%
Very Severe	4,500 psi (30.0 MPa)	0.40	1 inch (25 mm)	4S	6.0% +/- 1.5%
Maximum Water-Soluble Chloride Ion (Cl⁻) Content in Concrete, Percent by Weight of Cement^(5,6)					0.15
Maximum Chloride as Cl⁻ Concentration in Mixing Water, Parts Per Million					1000
Maximum Percentage of Total Cementitious Materials By Weight ^(7,9) (Very Severe Exposure Class Only):					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25

Slag Conforming to ASTM C989	50
Silica Fume Conforming to ASTM C1240	10
Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume ⁽⁸⁾	50
Total of Fly Ash or Other Pozzolans and Silica Fume ⁽⁸⁾	35
Alkali-Aggregate Reactivity Mitigation per ACI 201	
Slump (Conventional Concrete) per ASTM C143⁽¹⁰⁾	5 inches +/- 1½ inches (125 mm +/- 40 mm)
Slump Flow (Self-Consolidating Concrete) per ASTM C1611	18 inches – 32 inches (450 mm – 800 mm)

⁽¹⁾Exposure class is as described in ACI 318. “Moderate” describes concrete that is exposed to freezing and thawing cycles and occasional exposure to moisture. “Severe” describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture. “Very Severe” describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture and exposed to deicing chemicals. Exposure class should be specified by owner/purchaser prior to order placement.

⁽²⁾Test method ASTM C39.

⁽³⁾Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregates for Concrete*.

⁽⁴⁾Test method ASTM C231.

⁽⁵⁾Test method ASTM C1218 at age between 28 and 42 days.

⁽⁶⁾Where used in high sulfate environments or where alkali-silica reactivity is an issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)

⁽⁷⁾The total cementitious material also includes ASTM C150, C595, C845, C1157 cement. The maximum percentages shall include:

(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.

(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.

(c) Silica fume, ASTM C1240, present in a blended cement.

⁽⁸⁾Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

⁽⁹⁾Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze/thaw durability in a detailed and current testing program.

⁽¹⁰⁾Slump may be increased by a high-range water-reducing admixture.

D. Concrete reinforcing steel, when required for the specified block, shall conform to ASTM A615 and have a minimum yield strength of 60,000 psi. When required by the OWNER to be galvanized or epoxy-coated, reinforcing steel shall conform to ASTM A767 or ASTM A775, respectively, and have a minimum yield strength of 60,000 psi.

E. At least 1 inch of concrete cover shall be maintained over all reinforcing steel bars.

F. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	Dimension	Nominal Value	Tolerance
28" (710 mm) Block	Height	18" (457 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	28" (710 mm)	+/- 1/2" (13 mm)
41" (1030 mm) Block	Height	18" (457 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	40-1/2" (1030 mm)	+/- 1/2" (13 mm)
60" (1520 mm) Block	Height	18" (457 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	60" (1520 mm)	+/- 1/2" (13 mm)
52" (1320 mm) XL Block	Height	36" (914 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	60" (1520 mm)	+/- 1/2" (13 mm)

72" (1830 mm) XL Block	Height	36" (914 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	60" (1520 mm)	+/- 1/2" (13 mm)
96" (2440 mm) XL Block	Height	36" (914 mm)	+/- 3/16" (5 mm)
	Length	46-1/8" (1172 mm)	+/- 1/2" (13 mm)
	Width*	60" (1520 mm)	+/- 1/2" (13 mm)

* Block tolerance measurements shall exclude variable face texture

- G. With the exception of half-block units, corner units and other special application units, the precast modular block units shall have two (2), circular dome shear knobs that are 10 inches (254 mm), 7.5 inches (190 mm), or 6.75 inches (171 mm) in diameter and 4 inches (102 mm) or 2 inches (51 mm) in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. The Peak interlock shear between any two (2) vertically stacked precast modular block units, with 10-inch (254 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 6,500 lb/ft (95 kN/m) at a minimum normal load of 500 lb/ft (7kN/m). as well as an ultimate peak interface shear capacity in excess of 11,000 lb/ft (160 kN/m). The peak interlock shear between any two (2) vertically stacked precast modular block units, with 7.5-inch (190 mm) or 6.75-inch (171 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 1,850 lb/ft (27 kN/m) at a minimum normal load of 500 lb/ft (7kN/m) as well as an ultimate peak interface shear capacity in excess of 10,000 lb/ft (146 kN/m). Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 4,000 psi (27.6 MPa) concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.
- H. The 28-inch (710 mm) and 41-inch (1030 mm) precast modular block units may be cast with a continuous vertical core slot that will permit the insertion of a 12-inch (305 mm) inch wide strip of geogrid reinforcement to pass completely through the block. When installed in this manner, the geogrid reinforcement shall form a non-normal load dependent, positive connection between the block unit and the reinforcement strip. The use of steel for the purposes of creating the geogrid-to-block connection is not acceptable.
- I. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 14 ft - 6 in (4.42 m).
- J. The precast modular block units shall be manufactured with an integrally cast shear knobs that establishes a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the standard horizontal set-back facing batter options listed below:

18-inch High Blocks		36-inch High Blocks	
Horizontal	Max.	Horizontal	Max.
<u>Set-Back/Blk. Course</u>	<u>Facing Batter</u>	<u>Set-Back/Blk. Course</u>	<u>Facing Batter</u>
3/8" (10 mm)	1.2°	3-1/4" (83 mm)	5.2°
1-5/8" (41 mm)	5.2°		
9-3/8" (238 mm)	27.5°		
16-5/8" (422 mm)	42.7°		

The precast modular block units shall be furnished with the required shear knobs that provide the facing batter required in the construction shop drawings.

- K. The precast modular block unit face texture shall be selected by the OWNER from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 5.76 square feet (0.54 square meters) with a unique texture pattern that repeats with a maximum frequency of once in any 15 square feet (1.4 square meters) of wall face.
- L. The block color shall be selected by the OWNER from the available range of colors available from the precast modular block manufacturer.
- M. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 1.5" (38 mm) in its largest dimension and cracks not wider than 0.012" (0.3 mm) and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 0.75" (19 mm) in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.
- N. Preapproved Manufacturers: Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 05481 US 31 South, Charlevoix, MI 49720 USA; telephone (866) 222-8400; website www.redi-rock.com, or equal.
- O. Value Engineering Alternatives. The owner may evaluate and accept systems that meet the requirements of this specification after the bid date that provide a minimum cost savings of 20% to OWNER. Construction expediency will not be considered as a contributing portion of the cost savings total.

2.02 GEOGRID REINFORCEMENT

- A. Geogrid reinforcement shall be a woven or knitted PVC coated geogrid manufactured from high-tenacity PET polyester fiber with an average molecular weight greater than 25,000 ($M_n > 25,000$) and a carboxyl end group less than 30 ($CEG < 30$). The geogrid shall be furnished in prefabricated roll widths of certified tensile strength by the manufacturer. The prefabricated roll width of the geogrid shall be 12" (300 mm) +/- 1/2" (13 mm). No cutting of geogrid reinforcement down to the 12" (300 mm) roll width from a larger commercial roll width will be allowed under any circumstances.
- B. The ultimate tensile strength (T_{ult}) of the geogrid reinforcement shall be measured in accordance with ASTM D6637.
- C. Geogrid–Soil Friction Properties
 1. Friction factor, F^* , shall be equal to $2/3 \tan \phi$, where ϕ is the effective angle of internal friction of the reinforced fill soil.
 2. Linear Scale Correction Factor, α , shall equal 0.8.
- D. Long-Term Tensile Strength (T_{al}) of the geogrid reinforcement shall be calculated in accordance with Section 3.5.2 of FHWA-NHI-10-024 and as provided in this specification.
 1. The creep reduction factor (RCR) shall be determined in accordance with Appendix D of FHWA-NHI-10-025 for a minimum 75 year design life.

2. Minimum installation damage reduction factor (RFID) shall be 1.25. The value of RFID shall be based upon documented full-scale tests in a soil that is comparable to the material proposed for use as reinforced backfill in accordance with ASTM D5818.
 3. Minimum durability reduction factor (RFD) shall be 1.3 for a soil pH range of 3 to 9.
- E. Connection between the PMB retaining wall unit and the geogrid reinforcement shall be determined from short-term testing per the requirements of FHWA NHI-10-025, Appendix B.4 for a minimum 75-year design life.
 - F. The minimum value of T_{al} for geogrid used in design of a reinforced precast modular block retaining wall shall be 2,000 lb/ft (29 kN/m) or greater.
 - G. The minimum length of geogrid reinforcement shall be the greater of the following:
 1. 0.7 times the wall design height, H.
 2. 6 feet (1.83 m).
 3. The length required by design to meet internal stability requirements, soil bearing pressure requirements and constructability requirements.
 - H. Constructability Requirements. Geogrid design embedment length shall be measured from the back of the precast modular block facing unit and shall be consistent for the entire height of a given retaining wall section.
 - I. Geogrid shall be positively connected to every precast modular block unit. Design coverage ratio, R_c , as calculated in accordance with AASHTO LRFD Bridge Design Specifications Figure 11.10.6.4.1-2 shall not exceed 0.50.
 - J. Preapproved Geogrid Reinforcement Products. Miragrid XT Geogrids as manufactured by TenCate Geosynthetics of Pendergrass, Georgia USA and distributed by Manufacturers of the Redi-Rock Retaining Wall System.
 - K. Substitutions. No substitutions of geogrid reinforcement products shall be allowed.

2.03 GEOTEXTILE

- A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped joint between adjacent block units on the same course. The nonwoven geotextile fabric shall meet the requirements Class 3 construction survivability in accordance with AASHTO M 288.
- B. Geotextile shall be Mirafi 140N, Propex Geotex 451, Skaps GT-142, Thrace-Linq 140EX, Carthage Mills FX-40HS, Stratatex ST 142, or equal.

2.04 DRAINAGE

- A. Drainage aggregate (and wall infill for retaining walls designed as modular gravity structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D6913:

U.S. Standard Sieve Size	% Passing
1-½" (38 mm)	100
1" (25 mm)	95-100
½" (13 mm)	25-60

No. 4 (4.76 mm)	0-10
No. 8 (2.38 mm)	0-5

2.05 REINFORCED FILL

- A. Material used as reinforced backfill material in the reinforced zone (if applicable) shall be a granular fill material meeting the requirements of USCS soil type GW, GP, SW or SP per ASTM D2487 or alternatively by AASHTO Group Classification A-1-a or A-3 per AASHTO M 145. The backfill shall exhibit a minimum effective internal angle of friction, $\phi = 34$ degrees at a maximum 2% shear strain and meet the following particle-size distribution requirements per ASTM D6913.

U.S. Standard <u>Sieve Size</u>	<u>% Passing</u>
3/4" (19 mm)	100
No. 4 (4.76 mm)	0-100
No. 40 (0.42 mm)	0-60
No. 200 (0.07 mm)	0-15

- B. The reinforced backfill material shall be free of sod, peat, roots or other organic or deleterious matter including, but not limited to, ice, snow or frozen soils. Materials passing the No. 40 (0.42 mm) sieve shall have a liquid limit less than 25 and plasticity index less than 6 per ASTM D4318. Organic content in the backfill material shall be less than 1% per AASHTO T-267 and the pH of the backfill material shall be between 5 and 8.
- C. Soundness. The reinforced backfill material shall exhibit a magnesium sulfate soundness loss of less than 30% after four (4) cycles, or sodium sulfate soundness loss of less than 15% after five (5) cycles as measured in accordance with AASHTO T-104.
- D. Reinforced backfill shall not be comprised of crushed or recycled concrete, recycled asphalt, bottom ash, shale or any other material that may degrade, creep or experience a loss in shear strength or a change in pH over time.

2.06 LEVELING PAD

- A. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the RWDE.
- B. Crushed stone used for construction of a granular leveling pad shall meet the requirements of the drainage aggregate and wall infill in section 2.04 or a preapproved alternate material.
- C. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 2,500 psi (17.2 MPa).

2.07 DRAINAGE

- A. Drainage Pipe:
1. Drainage collection pipe shall be a 4" (100 mm) diameter, 3-hole perforated, HDPE pipe with a minimum pipe stiffness of 22 psi (152 kPa) per ASTM D2412.

2. The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.
- B. Preapproved Drainage Pipe Products: ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems, or equal.

PART 3–EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with OSHA safety standards, state and local building codes and manufacturer's requirements.
- B. CONTRACTOR is responsible for the location and protection of all existing underground utilities. Any new utilities proposed for installation in the vicinity of the retaining wall, shall be installed concurrent with retaining wall construction. CONTRACTOR shall coordinate the work of subcontractors affected by this requirement.
- C. New utilities installed below the retaining wall shall be backfilled and compacted to a minimum of 98% maximum dry density per ASTM D698 standard proctor.
- D. CONTRACTOR is responsible to provide safe excavations and embankments are maintained throughout the course of the project.
- E. All work shall be inspected by the Inspection Engineer.

3.02 EXAMINATION

- A. Prior to construction, CONTRACTOR, Grading Contractor, RWIC and Inspection Engineer shall examine the areas in which the retaining wall will be constructed to evaluate compliance with the requirements for installation tolerances, worker safety and any site conditions affecting performance of the completed structure. Installation shall proceed only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

- A. Fill Soil.
 1. The Inspection Engineer shall verify that reinforced backfill placed in the reinforced soil zone satisfies the criteria of this section.
 2. The Inspection Engineer shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the RWDE as shown on the construction drawings.
- B. Excavation.
 1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.
 2. Over-excavated soil shall be replaced with compacted fill in conformance with the specifications of the RWDE and "Division 31, Section 31 20 00 – Earthmoving" of these project specifications.

3. Embankment excavations shall be bench cut as requested by the project Geotechnical Engineer and inspected by the Inspection Engineer for compliance.
- C. Foundation Preparation.
1. Prior to construction of the precast modular block retaining wall, the leveling pad area and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as requested by the project Geotechnical Engineer. The Inspection Engineer shall see that the undercut limits are consistent with the requirements of the project Geotechnical Engineer and that all soil fill material is properly compacted in accordance with project specifications. The Inspection Engineer shall document the volume of undercut and replacement.
 2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.
 - a. The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.
 - b. The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings per paragraph 1.06 I of this section.
- D. Leveling Pad.
1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.
 2. Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum lifts of 6" (150 mm). The crushed stone shall be compacted by a minimum of 3 passes of a vibratory compactor capable of exerting 2,000 lb (8.9 kN) of centrifugal force and to the satisfaction of the Inspection Engineer.
 3. Unreinforced Concrete Leveling Pad. The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. The RWIC shall erect proper forms as required to provide for the accurate placement of the concrete leveling pad according to the retaining wall construction drawings.

3.04 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

- A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer's recommendations and these specifications, these specifications shall prevail.
- B. Drainage components. Pipe, geotextile and drainage aggregate shall be installed as shown on the construction shop drawings.
- C. Precast Modular Block Installation:
1. The first course of block units shall be placed with the front face edges tightly abutted together on the prepared leveling pad at the locations and elevations shown on the construction drawings. The RWIC shall take special care so that the bottom course of

block units are in full contact with the leveling pad, are set level and true and are properly aligned according to the locations shown on the construction drawings.

2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks to a minimum distance of 12" (300 mm) behind the block unit. If stone infill of hollow core blocks exceeds 45% of the block design volume, drainage aggregate will not be required to extend beyond the back of the blocks, with the approval of the RWDE.
3. Drainage aggregate shall be placed in 9-inch maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 2,000 lb (8.9 kN) of centrifugal force.
4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.
5. Base course blocks for gravity wall designs (without geosynthetic soil reinforcement) may be furnished without vertical core slots. If so, disregard item 4 above, for the base course blocks in this application.
6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil (gravity wall design) or between the drainage aggregate and the reinforced fill (reinforced wall design) as required on the retaining wall construction drawings.
7. Subsequent courses of block units shall be installed with a running bond (half block horizontal course-to-course offset). With the exception of 90-degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to provide consistent face batter and wall alignment. Geogrid, drainage aggregate, unit core fill, geotextile and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
8. The elevation of retained soil fill shall not be less than 1 block course (18 inches (457 mm)) below the elevation of the reinforced backfill throughout the construction of the retaining wall.
9. If included as part of the precast modular block wall design, cap units shall be secured with an adhesive in accordance with the precast modular block manufacturer's recommendation.

D. Geogrid Reinforcement Installation (if required)

1. Geogrid reinforcement shall be installed at the locations and elevations shown on the construction drawings on level fill compacted to the requirements of this specification.
2. Continuous 12" (300 mm) wide strips of geogrid reinforcement shall be passed completely through the vertical core slot of the precast modular block unit and extended to the embedment length shown on the Drawings. The strips shall be staked or anchored as necessary to maintain a taut condition.
3. Reinforcement length (L) of the geogrid reinforcement is measured from the back of the precast modular block unit. The cut length (L_c) is two times the reinforcement length plus additional length through the block facing unit. The cut length is calculated as follows:

$$L_c = 2*L + 3 \text{ ft } (2*L + 0.9 \text{ m}) \text{ (28" (710 mm) block unit)}$$
$$L_c = 2*L + 5 \text{ ft } (2*L + 1.5 \text{ m}) \text{ (41" (1030 mm) block unit)}$$

4. The geogrid strip shall be continuous throughout its entire length and may not be spliced. The geogrid shall be furnished in nominal, prefabricated roll widths of 12" (300 mm) +/- 1/2" (13 mm). No field modification of the geogrid roll width shall be permitted.
 5. Neither rubber tire nor track vehicles may operate directly on the geogrid. Construction vehicle traffic in the reinforced zone shall be limited to speeds of less than 5 mph (8 km/hr) once a minimum of 9 inches (230 mm) of compacted fill has been placed over the geogrid reinforcement. Sudden braking and turning of construction vehicles in the reinforced zone shall be avoided.
- E. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:
1. Deviation from the design batter and horizontal alignment, when measured along a 10' (3 m) straight wall section, shall not exceed 3/4" (19 mm).
 2. Deviation from the overall design batter shall not exceed 1/2" (13 mm) per 10' (3 m) of wall height.
 3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be 1/2" (13 mm).
 4. The base of the precast modular block wall excavation shall be within 2" (50 mm) of the staked elevations, unless otherwise approved by the Inspection Engineer.
 5. Differential vertical settlement of the face shall not exceed 1' (300 mm) along any 200' (61 m) of wall length.
 6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be 1/2" (13 mm).
 7. The wall face shall be placed within 2" (50 mm) of the horizontal location staked.

3.05 WALL INFILL AND REINFORCED BACKFILL PLACEMENT

- A. Backfill material placed immediately behind the drainage aggregate shall be compacted as follows: 98% of maximum dry density at $\pm 2\%$ optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.
- B. Compactive effort within 3' (0.9 m) of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of maximum dry density as measured in accordance with ASTM D698 standard proctor or 80% relative density per ASTM D 4254. Heavy equipment should not be operated within 3' (0.9 m) of the back of the precast modular blocks.
- C. Backfill material shall be installed in lifts that do not exceed a compacted thickness of 9" (230 mm).
- D. At the end of each work day, the RWIC shall grade the surface of the last lift of the granular wall infill to a $3\% \pm 1\%$ slope away from the precast modular block wall face and compact it.
- E. CONTRACTOR shall direct the Grading Contractor to protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation or erosion of the reinforced backfill or wall infill.

3.06 OBSTRUCTIONS IN THE INFILL AND REINFORCED FILL ZONE

- A. The RWIC shall make all required allowances for obstructions behind and through the wall face in accordance with the approved construction shop drawings.
- B. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the affected portion of the wall shall not be constructed until the RWDE can appropriately address the required procedures for construction of the wall section in question.

3.07 COMPLETION

- A. For walls supporting unpaved areas, a minimum of 12" (300 mm) of compacted, low-permeability fill shall be placed over the granular wall infill zone of the precast modular block retaining wall structure. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.
- B. For retaining walls with crest slopes of 5H:1V or steeper, silt fence shall be installed along the wall crest immediately following construction. The silt fence shall be located 3' to 4' (0.9 m to 1.2 m) behind the uppermost precast modular block unit. The crest slope above the wall shall be immediately seeded to establish vegetation. CONTRACTOR shall provide the seeded slope with adequate irrigation and erosion protection to support germination and growth.
- C. CONTRACTOR shall confirm that the as-built precast modular block wall geometries conform to the requirements of this section. CONTRACTOR shall notify OWNER of any deviations.

END OF SECTION

SECTION 32 92 00

RESTORATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Placement of topsoil.
 - 2. Fertilizing.
 - 3. Seeding.
 - 4. Mulching.
 - 5. Maintenance.
- B. All areas disturbed by street, curb and gutter, and sidewalk construction shall be restored. Backslopes adjacent to the sidewalk shall be seeded to the slope intercept. Borrow sites and disposal sites will not require seeding, but they shall be graded smooth.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. Payment: Payment for restoration shall be at the lump sum price bid. Costs for topsoiling, seeding, fertilizer, mulching, and maintenance of restored areas shall be included in the lump sum price bid. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Ohio Department of Transportation, Construction and Material Specifications, current edition, including all issued supplemental specifications.

1.03 QUALITY ASSURANCE

- A. All work shall be in accordance with Standard Specifications, unless noted otherwise.

PART 2–PRODUCTS

2.01 TOPSOIL

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, stones greater than 3/4 inches in size, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil from the site may be used if it meets the above requirements.

2.02 SEED

- A. Seed mixture shall be Class 1 Lawn Mixture per Item 659.

2.03 FERTILIZER

- A. Fertilizer shall be in accordance with Item 659.04.

PART 3—EXECUTION

3.01 TOPSOIL

- A. Placing topsoil shall be in accordance with Item 659 of the Standard Specifications. Topsoil shall be placed to a uniform depth of 6 inches in place. Topsoil placement shall be incidental to sodding or seed, fertilizer, and mulching.

3.02 SEEDING

- A. Seeding shall be performed in accordance with Item 659 of the Standard Specifications.
- B. Seed shall be applied at the rates specified in Item 659 of the Standard Specifications.

3.03 FERTILIZER

- A. Fertilizer shall be applied per Item 659 of the Standard Specifications.

3.04 MULCHING

- A. All areas receiving seed shall be mulched.
- B. Mulching shall be straw mulch performed in accordance with Item 659 of the Standard Specifications.

3.05 MAINTENANCE

- A. Seeding/sodding shall proceed concurrently with construction. Seeding/sodding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- B. Mow sod at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Immediately remove clippings after mowing.
- D. Water to prevent seed/sod and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas.
- H. Immediately replace sod in areas which show bare spots or deterioration.

- I. Protect seeded areas with warning signs during maintenance period.
- J. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding or resodding if damage occurs prior to acceptance of work.

END OF SECTION

SECTION 32 92 19

SEEDING AND SODDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Preparation of subsoil.
 - 2. Topsoil.
 - 3. Seeding, sodding, mulching or erosion mat, and fertilizing.
 - 4. Maintenance.
- B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the drawings shall be seeded or sodded. Prior to seeding or sodding, disturbed areas shall be graded to subgrade for placement of topsoil. Surfaces on 3-to-1 slope or less may either be seeded or sodded, but surfaces on greater than 3-to-1 slope shall be sodded.
- C. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.
- D. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for topsoil, seeding, fertilizer, mulching, erosion mat, and maintenance of restored areas shall be included in the lump sum bid. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas.

1.03 REFERENCES

- A. FS O-F-241–Fertilizers, Mixed, Commercial.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the Construction and Material Specifications, State of Ohio Department of Transportation, 2019 Edition, including all issued supplemental specifications.

1.04 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing when suspended vertically by holding the upper two corners. Submit sod certification for grass species and location of sod source.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver sod on pallets or in rolls. Protect exposed roots from dehydration. Do not deliver more sod than can be laid within 24 hours.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2–PRODUCTS

2.01 SEED MIXTURE

- A. Seed mix Class 1–Lawn Mixture per Standard Specifications. Use blue tag certified seed. Each seed lot will be subject to sampling and testing by the state seed laboratory.
- B. Weed content shall not exceed 0.5% in mixture.

2.02 SOD

- A. Sod shall conform to Section 660 of the Standards Specifications.
- B. Netting or fabric for sod reinforcement shall be in accordance with Section 660 of the Standard Specifications.
- C. Anchorage staples shall be in accordance with Section 660 of the Standard Specifications.

2.03 SOIL MATERIALS

- A. Topsoil shall consist of salvaged topsoil or hauled-in topsoil in accordance with Sections 651, 652, or 653, as applicable, of the Standard Specifications.
- B. Amend topsoil with lime as necessary in accordance with Section 659 of the Standard Specifications.
- C. Engineered Soil: Bioretention Basins require overexcavation, decompaction, and reconstruction with 24 inches of engineered soil except where noted otherwise. Engineered soil shall be provided in conformance with the criteria specified in Rainwater and Land Development Manual by the Ohio Department of Natural Resources, Third Edition 2006 (as updated, Chapter 210–Bioretention Area.).

2.04 ACCESSORIES

- A. Mulching material shall be in accordance with Section 659 of the Standard Specifications.
- B. Fertilizer shall be in accordance with Section 659 of the Standard Specifications for Type A fertilizer. Fertilizer shall be provided for seed and sod locations.

- C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.
- D. CONTRACTOR shall be responsible for watering in accordance with Section 659 and Section 660 of the Standard Specifications.
- E. Lime shall be in accordance with Section 659 of the Standard Specifications.

PART 3—EXECUTION

3.01 GENERAL

- A. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.

3.02 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.03 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat deep (> 12 inches) subsoiling or cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.04 PLACING TOPSOIL

- A. Place topsoil in accordance with Sections 651, 652, or 653, as applicable, of the Standard Specifications.
- B. Spread topsoil to a minimum depth of 6 inches over area to be seeded. Rake until smooth.
- C. Place topsoil during dry weather and on dry unfrozen subgrade.
- D. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.
- E. Grade topsoil to eliminate rough, low or soft areas, and to provide positive drainage.
- F. Manually spread topsoil around trees, plants, and buildings to prevent damage.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.
- H. Engineered topsoil placement of 24 inches by CONTRACTOR is required within bioretention basin areas except as noted otherwise.

3.05 FERTILIZING

- A. Apply fertilizer in accordance with Section 659 of the Standard Specifications.
- B. Apply fertilizer after smooth raking of topsoil and prior to installation of seed or sod, no more than 18 hours before seeding or 48 hours before sodding.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.06 SEEDING

- A. Apply seed in accordance with Section 659 of the Standard Specifications. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.
- B. Planting season shall be between March 1 and October 30.
- C. Do not sow immediately following rain, when ground is too dry or during windy periods.
- D. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- E. Place erosion control mats in accordance with Section 31 25 00–Slope Protection and Erosion Control.

3.07 LAYING SOD

- A. Place sod in accordance with Section 660 of the Standard Specifications.
- B. Moisten prepared surface immediately prior to laying sod.
- C. Lay sod immediately after delivery to site to prevent deterioration.
- D. Lay sod tight with no open joints visible and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- E. Lay smooth. Align with adjoining grass areas.
- F. Sod placement on slopes shall be completed in accordance with Section 660 of the Standard Specifications.
- G. All sod placed in ditches, flumes, or other appurtenances where a concentrated flow of water may be expected shall be staked regardless of the slope.
- H. Water sodded areas immediately after installation. Saturate sod to 4-inch depth of soil.
- I. All sodded areas shall be kept thoroughly moist until the sod is established. Sod that dies during correction period shall be replaced at no cost to OWNER.

3.08 MAINTENANCE

- A. Seeding or sodding shall proceed concurrently with the main construction. Seeding or sodding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.

3.09 MAINTENANCE

- A. Mow grass at regular intervals to maintain at a height between 2 1/2 inches and 3 1/2 inches. Do not cut more than one-third of grass blade at any one mowing.
- B. Immediately remove clippings after mowing.
- C. Water to prevent grass and soil from drying out.
- D. Roll surface to remove minor depressions or irregularities.
- E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- F. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas. Immediately replace sod in areas which show bare spots or deterioration.
- G. Protect seeded areas with warning signs during maintenance period.
- H. Immediately reseed areas which do not show a satisfactory stand of established grass, and resod areas that do not show satisfactory establishment.
- I. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding if damage occurs prior to acceptance of work.
- J. Maintain seeded lawns for not less than 60 days after substantial completion.
- K. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.
- L. Maintain sodded lawns for not less than 30 days after substantial completion.
- M. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth acceptable lawn free of eroded or bare areas.

END OF SECTION

SECTION 32 94 00

STONE MULCH

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Stone mulch.
 - 2. Maintenance.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

PART 2–PRODUCTS

2.01 MULCH MATERIALS

- A. Stone Mulch: Stone mulch shall be 1 1/2-inch decorative landscape stone.

2.02 ACCESSORIES

- A. Membrane: 20 mil thick, water permeable polyolefin fabric.

PART 3–EXECUTION

3.01 TREE REMOVAL AND REPLACEMENT

- A. Trees marked for removal within street and road rights-of-way and in easements shall be removed by CONTRACTOR and properly disposed. Trees within street and road rights-of-way marked for removal need not be replaced unless specifically noted otherwise on drawing. CONTRACTOR shall replace all other removed and damaged trees and shrubs with new stock at its expense. New trees shall be located as requested by OWNER or ENGINEER.
- B. Trees shall be replaced as follows. Diameters shall be measured 4 feet above the ground.

Deciduous Trees

Up to 1 1/2 inches

Like size and type

Greater than 1 1/2 inches

Min. 1 1/2 inches of like type

Coniferous Trees

Up to 6 feet tall

Like size and type

Greater than 6 feet tall

Min. 6-foot tree of like type

- C. All bushes and shrubs removed during construction shall also be restored to their original position and condition. If the bush or shrub is damaged or dies after restoring,

CONTRACTOR shall replace it with one of same kind and size up to a height of 4 feet. Bushes and shrubs beyond this height shall be replaced by one that is 4 feet.

- D. It is intended that as many trees as possible be saved during construction. No trees, except those so designated, shall be removed without prior approval of OWNER. CONTRACTOR shall conduct the work to protect all trees to remain. CONTRACTOR shall provide suitable fencing installed at the tree drip line for all trees within the construction area to protect trees from damage and soil compaction by its equipment.
- E. Trees that are damaged during construction shall be repaired. CONTRACTOR shall retain the services of a professional nurseryman who is a member of the National Arborist Association to direct CONTRACTOR on the proper repair of damaged trees. Damaged limbs and roots shall be pruned or dressed according to recommendations of the nurseryman. Backfill shall be replaced as soon as possible to reduce exposure of roots to air. Scarfed areas on trees shall be suitably dressed. Compaction of root areas under the drip line of the tree is to be avoided whenever possible.
- F. When removing trees, special care shall be taken to not damage surrounding private property. Costs for tree removal or replacement and construction around trees shall be included in the price bid for the work.
- G. CONTRACTOR shall relocate or bore and jack under or by such trees as desired to minimize construction damage. Cost for such construction shall be included in the price bid for the work.

3.02 INSTALLATION OF ACCESSORIES

- A. Place membrane (weed barrier) in all areas to receive stone mulch.

3.03 MULCH

- A. Place stone mulch to 3-inch depth over membrane in all areas indicated on the drawings.

3.04 MAINTENANCE

- A. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

END OF SECTION

SECTION 33 00 10

BURIED PIPING AND APPURTENANCES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All underground piping, valves, and appurtenances of every description.
 - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
 - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the Ohio Department of Transportation, Standard Specifications, latest edition.
- B. Plumbing Code: Unless otherwise indicated, plumbing code within this section shall refer to the 2017 Ohio Plumbing Code.
- C. Ten State Standards.

1.03 SUBMITTALS

- A. Shop Drawings: General arrangement drawings of 3 inches or larger exterior (below ground) ductile iron, stainless steel and welded steel piping shall be submitted to ENGINEER for approval. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, pipe restraint, valves, and appurtenances.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.

2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

2.02 MANHOLES AND UNDERGROUND UTILITY STRUCTURES

- A. General: All provisions of the drawings, enclosed in these specifications, except those contrary to provisions delineated herein or on the drawings shall apply to manholes. For purposes of this specification, the STR 50 RAS Valve Vault and STR 80 Valve Vault are defined as underground utility structures.
- B. Unless otherwise specified or shown on the drawings for special manholes, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C478. Solid precast manhole bottoms shall be provided except where shown on the drawings. Manholes shall be provided with minimum diameters as shown on the Drawings. Diameters shall be increased from the minimum for the following:
1. To provide between adjacent pipe a minimum distance equal to one-half the outside diameter of the largest pipe measured circumferentially along the inside face of the manhole.
 2. To accommodate flexible manhole connections used.
 3. To accommodate multiple valves or valve assemblies.
- C. Manhole top sections shall be precast reinforced eccentric cones unless precast reinforced flat slabs are specifically required or shown on the Drawings or are necessary because of shallow depth. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.
- D. Unless otherwise specified or shown on the drawings, all underground utility structures shall be precast, reinforced concrete. Reinforced concrete base sections, riser sections, and flat slabs shall conform to the requirements of ASTM C858. Flat slabs shall be designed for HS20 loadings. Solid precast bottoms shall be provided unless otherwise shown on the drawings.
- E. Manhole and underground utility structure sections shall be provided in such combinations as to conveniently make up the required depth of the manholes or structure. A maximum of two handling holes per manhole section and four handling holes per utility structure section will be permitted. All joints shall be tongue and groove and shall be sealed with rubber O-ring gaskets of circular cross section or mastic compounds. Gaskets shall conform to ASTM C443. Mastic compounds shall be Ram-nek, Kent-Seal, Mas-stik, or equal.
- F. Except as otherwise specified, connection of pipes to manholes and underground utility structure shall be with Kor-N-Seal, A LOK, Interpace, PS-X, or equal joint. The joint shall provide a flexible, watertight connection between pipe and manhole. Manhole connections for storm sewer mains and leads may be made with poured-in-place concrete during completion of manhole interior in lieu of above.
- G. Manhole Chimney Adjusting Rings: Provide concrete manhole adjusting rings.

- H. Frames and Covers:
 - 1. Frames and covers shall be provided for the openings indicated on the drawings.
 - 2. For standard manholes, frames shall be Neenah R-1550, or equal, with Type B lid, with two concealed pickholes equipped with self-sealing gaskets. Frames for valve manholes shall be Neenah R-6065 with Type B lid R-5900-F with Type C lid with two concealed pickholes equipped with self-sealing gaskets, or equal. Catch basin grates shall be Neenah R-1550 with machined frame and Type D open grate, or equal. Interior mud basin castings shall be Neenah R-6118, or equal, with grey iron Class 35 frame and grating for heavy-duty use.
 - 3. Cover for underground utility structure shall be provided with pumps as specified in Section 43 25 10 and delivered to underground structure manufacturer. Other Covers shall be as specified in Section 08 31 13.
 - 4. Covers shall be reinforced for HS20 loading. Provide stainless steel or fiberglass unistruts as necessary attached to covers to mount accessories, guides, etc.
- I. Manhole Chimney Seals:
 - 1. External manhole chimney seals shall be provided for all new manholes. Chimney seal shall be Cretex, or equal.
 - 2. Existing manholes exposed during the construction period shall have the adjustment rings replaced and a new chimney seal installed. Existing castings shall be reused.
- J. Valve boxes shall be provided for all buried valves. Valve boxes shall be Tyler/Union 6850 Series, 4 inches through 12 inches, or equal. Extension heights shall be provided as required. Lids shall be marked for appropriate use. CONTRACTOR shall verify that all valve boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.
- K. Floor boxes shall conform to Section 40 05 00–Piping and Appurtenances.
- L. Storm sewer manholes and curb inlets shall be constructed as shown on the drawings. Except as otherwise specified, manhole covers shall be Neenah R-1550, or equal, with Type B lid with two concealed pickholes and self-sealing gaskets.
- M. Curb inlets in standard curb and gutter sections shall be Neenah R-3067, or equal, with Type R reversible grate. Manhole connections for storm sewer mains shall be made with poured-in-place concrete during completion of the manhole. Inlets located in driveway sections of curb and gutter shall be Neenah R-3290A with Type C grate, or equal.
- N. Area drains as shown on the Drawings shall be constructed using a section of 24-inch-diameter RCP bell and spigot joint pipe. Castings for area drains shall be Neenah R-4360D grate with frames. The pipe bell i.d. shall be greater than the casting o.d. so that the casting will fit within the bell without becoming wedged against the side of the pipe.

2.03 BURIED PIPING

- A. Ductile Iron Piping and Fittings:
 - 1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints. Unless otherwise shown or specified, all piping shall be minimum Special Thickness Class 53 with a minimum rated working pressure of 250 psi. Pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as

shown on the drawings for laying condition 4 Special Thickness Class 53 minimum, unless otherwise shown or specified.

2. The words "Ductile Iron" and the weight and class of pipe shall be plainly marked on each piece of pipe.
3. Except as otherwise specified, underground pipe shall have mechanical joints conforming to AWWA C110 and C111 with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Underground aeration piping shall have FKM gaskets designed for a minimum of 300°F. Bolts on exterior joints shall be high-strength low-alloy steel (Corten, or equal), conforming to AWWA C111. Certificate to that effect shall be provided.
4. Restrained joints shall be provided in accordance with Part 3–Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint.
5. Joint restraint is not required for gravity sewers, drains, and those pipes designated in Paragraph 1. of 3.02.G. Infiltration/Exfiltration Tests. Joint restraint shall be provided for any pipe requiring pressure testing.
6. Underground pipe shall have mechanical joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
7. Unless otherwise specified, all ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
8. All ductile iron piping and fittings designated A (Air) shall be unlined and shall receive exterior coating as specified above.
9. Piping and fittings for installation in manholes and wet wells shall be flanged and provided as specified in Section 40 05 00–Piping and Appurtenances.
10. Drainage Piping: All process drain piping and all underground piping designated as drain (D) shall be ductile iron. All underground drainage piping more than 2 feet from building walls shall be ductile iron as specified. Connections to drainage piping from buildings shall be made within 2 feet from the building wall and shall be made with a Fernco, or equal, flexible coupling.

B. Reinforced Concrete Pipe:

1. Reinforced concrete pipe for storm sewer shall meet the requirements of ASTM C76, for circular pipe, ASTM C507 for elliptical pipe, ASTM C655 for D-load pipe, or ASTM C1433 for box culvert pipe. All pipes shall have a smooth interior wall. Strength and class of the pipe shall conform to the Drawings and as specified herein. All reinforced concrete pipe used in the work shall be of adequate strength to support the trench loads applied. Unless otherwise shown or specified, all reinforced concrete pipe shall be Class V minimum and shall have a minimum "B" wall construction. All reinforcing cages shall be circular for circular pipe. All reinforcing cages shall be elliptical for elliptical pipe. Reinforcing cage shall extend to the full width into the bell end of the pipe and to within one inch of the spigot end of the pipe.
2. Standard and special fittings shall be of approved manufacturer and shall conform to requirements of the trade and these specifications. All fittings shall be of a strength at least equal to that of the sewer main and shall be jointed with the same type of joint as used in the sewer main.
3. Not more than one lift hole per length of pipe shall be used in storm sewer.

4. Reinforced concrete pipe and fittings shall be provided with joints and gaskets that meet ASTM C443 or ASTM C361 for storm sewer pipe. Joints for circular and elliptical storm sewer shall be sealed with rubber gaskets having a continuous O-ring cross section, Tylox Superseal, or equal. All pipe shall be specifically built to fit the gasket used. Provide precast concrete endwalls on all storm sewers.
5. Joints for all smooth exterior wall reinforced concrete Storm pipe (except where open cut is not allowed) shall be provided with an external bitumastic wrap, Mac Wrap, or equal. Wrap shall be minimum 12 inches wide and shall be secured on the pipe with a minimum of one stainless steel band seal connector on each side of the joint.
6. Nonstandard pipe lengths may be used at manholes and structures as necessary to allow them to be located at the locations identified on the Drawings. Reinforced concrete bends, tees, and reducers shall be manufactured to provide for the required transitions as shown on the Drawings. Sufficient additional reinforcement shall be added at the spring lines and top and bottom of the pipe to prevent shearing after installation. Repairs to complete fabricated pipe fittings shall be such that the completed unit shall have the same strength as that of the remainder of the pipe barrel and the concrete used to complete the section shall not spall or separate.
7. Concrete apron endwalls for concrete pipe sewers shall be manufactured with reinforcement and concrete conforming to the pertinent requirements for minimum Class II, Wall B, reinforced concrete pipe as specified in ASTM C76. Concrete apron endwalls for concrete elliptical pipe sewers shall be manufactured with reinforcement and concrete conforming to the pertinent requirements for Class HE-III reinforced concrete elliptical pipe as specified in ASTM C507. Joint ties shall be installed at the last two downstream joints on any pipe run ending in an apron endwall that is constructed with reinforced concrete pipe of any type or size.
8. Acceptance of reinforced concrete pipe shall be on the basis of plant load-bearing tests, material tests, and inspection of manufactured pipe for visual defects and imperfections.
9. Cement used in the manufacture of reinforced concrete pipe shall meet the requirements of ASTM C150, Standard Specification for Portland Cement for Type II cement.
10. A three-edge bearing test shall be conducted by the manufacturer according to ASTM C497 as proof of design by determining the ultimate load capacity of the pipe. One segment of pipe from each pipe class must pass the three-edge bearing test such that the load required to produce the ultimate load exceeds the load rating of the pipe. The test results shall be maintained in a log and provided to OWNER. Manufacturer shall also maintain concrete cylinder testing data and quality control records to verify that pipe meets the required ASTM standards.
11. An alkalinity test shall be conducted on the concrete mixture used for each type and class of reinforced concrete pipe used in the Project. The alkalinity test shall be conducted according to ASTM C497 and the alkalinity of all concrete mixtures shall be equal to or greater than 0.2 grams of CaCO₃ equivalent reactivity per gram of concrete. The manufacturer shall complete the alkalinity tests.
12. The costs of the tests shall be incidental to the pipe cost. CONTRACTOR shall include all such costs in the price bid for the Work. CONTRACTOR shall submit a signed, dated, and certified copy of the test data to OWNER (in a format acceptable to OWNER) for review prior to delivering any pipe to the Project site. No additional compensation will be made to CONTRACTOR for the required testing.
13. The pipe leakage shall not exceed 150 gallons/day/inch inside diameter/mile of pipe. The manufacturer shall provide a written and signed statement indicating the pipe meets this criterion.
14. CONTRACTOR shall provide written certification that pipe meets the standards herein.

- C. Copper Water Tubing:
1. Copper tubing installed within trenches shall be Type K soft annealed seamless copper tubing and shall conform to the Specifications of ASTM B88. All other copper shall be Type K hard copper conforming to ASTM B88.
 2. Fittings shall be of the flared or compression type. Unions shall be extra heavy three-part unions only. Joints shall not be sued under floor slabs.
 3. The name or trademark of the manufacturer and a mark indicating the type shall be permanently and plainly marked on tubing.
 4. Fittings for copper tubing shall be copper alloy meeting the requirements of AWWA C800-14. The maximum lead content shall be 0.25%. They shall have uniformity in wall thickness and strength and shall be free from any defect that may affect their serviceability.
 5. Each fitting shall be permanently and plainly marked with the name or trademark of the manufacturer.
 6. Shutoff valves shall be placed on each branch for all underground piping.
- D. Solid Wall PVC:
1. Polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM D3034 for pipe sizes 4 inches through 15 inches and ASTM F679 for pipe sizes 18 inches through 60 inches.
 2. PVC material for ASTM D3034 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Pipe shall have a maximum standard dimension ratio (SDR) of 35.
 3. PVC material for ASTM F679 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with a minimum modulus of elasticity of 500,000 psi. Pipe stiffness shall be a minimum 115 psi when tested in accordance with ASTM D2412.
 4. Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have experience records substantiating acceptable performance of the pipe and fittings to be furnished. The minimum wall thickness of fittings shall be the same as the pipe to which it connects.
 5. Acceptance of piping and fittings shall be subject to tests conducted in accordance with ASTM D3034 and/or ASTM F679.
 6. Fittings such as saddles, elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.
 7. Joints shall be of the elastomeric type for pipes 4 inches or larger and elastomeric or solvent cement for pipes less than 4 inches.
 8. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory-installed positively restrained gasket.
 9. Solvent cement joints shall be assembled using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.
 10. The assembled joint shall pass the performance tests as required in ASTM D3212.
- E. Gravity Sanitary Sewer Service Branches and Laterals:
1. Branches (tees and wyes) shall be of the same material as the main except for reinforced concrete pipe used for sanitary sewer. For reinforced concrete pipe, special

branches shall be furnished and installed to accept the lateral. Such special branches are subject to review by ENGINEER.

2. If a different thermoplastic material is specified for laterals than for the main line, appropriate solvent welds, fittings, transition couplings, and other appurtenances shall be provided to effect a water tight seal.
3. Fittings for laterals shall be of the same material as the lateral pipe unless special fittings are needed for transition between material types or sizes or standard fittings are not manufactured.
4. Where the wye or tee branches and laterals are of dissimilar materials, CONTRACTOR shall provide a transition coupling for the connection.
5. All fittings used, including type of jointing, are subject to review by ENGINEER.

F. HDPE Water Piping:

1. Buried HDPE piping may be used instead of buried copper piping for PW, NPW, DEW piping 2-inch diameter or less.
2. HDPE piping shall be copper tube size (CTS) and meet NSF Standard 61.
3. Resin Compounds: Polyethylene materials used shall be of high density polyethylene (HDPE), meeting 1600 Design Stress @ 23°C or 1000 Design Stress @ 60°C, applicable requirements for PE4710 pipe and tubing as defined by ASTM D-3350, Cell Classification 445576E.
4. Piping shall be permanently indented every two feet along the pipe barrel, identifying the pipe with manufacturer's name or logo, pressure rating, nominal size, NSF logo, and QC control codes.
5. HDPE pipe fittings shall be compatible with and from the same manufacturer as HDPE piping, shall be equal in material and construction to that of HDPE piping, and shall be fusion butt-welded to piping.
6. Fusion welding of HDPE piping shall be in accordance with applicable standards, codes, and specifications. Welders shall be trained and certified for this practice. CONTRACTOR shall provide certification similar to that specified under Section 33 30 10 1.03 for welders if requested and all welds are subject to testing as specified.
7. Shut off valves shall be placed on each branch of underground piping as specified or as shown on Drawings.
8. Brass quick joint couplings (Ford Meter Box Company, or equal) made specifically for HDPE piping may be used on a limited basis and subject to approval by ENGINEER. Couplings shall conform to AWWA Standard C800. Couplings shall meet NSF 61. No couplings shall be installed under floor slabs.
9. Provide tracer wire as specified with buried HDPE piping.

G. HDPE Corrugated Pipe:

1. Corrugated pipe composed of high density polyethylene shall meet the requirements of AASHTO M252 and M294. Pipe and fittings shall be made from virgin polyethylene compounds conforming to ASTM D3350.
2. Pipe shall have interior smooth inner wall of full circular cross section with an integrally formed outer corrugated wall AASHTO Type S designation.
3. Fittings may be molded or fabricated and shall not impair the integrity or function of the pipe. Only fittings supplied or recommended by pipe manufacturer shall be used. Where elastomeric gaskets are required, they shall conform to ASTM F477.

H. HDPE Pipe and Fittings:

1. HDPE pressure rated pipe shall conform to the requirements of AWWA C906 for pipe from 4 inches through 65 inches. HDPE pipe shall be manufactured from material conforming to PE Code PE4710.
2. HDPE pipe outside diameter shall conform to ductile iron pipe sizes (DIPS). The type of HDPE material, nominal pipe size, standard dimension ratio, and pressure rating shall be not less than pressure class 250 and not greater than a dimension ratio (DR) 9.
3. Markings on the pipe shall include the following: Nominal pipe size, type of plastic pipe material, DR number, pressure class rating, manufacturer's name, and the seal or mark of the laboratory making the evaluation of the suitability of the pipe for the transport of potable water.
4. Fittings for HDPE pipe shall conform to AWWA C906 and shall have the same pressure rating as the pipe in which they are installed.

I. Tracer Wire:

1. Install 10 gauge solid tracer wire with buried pipe where specified. Wire shall be continuous and terminate at valve boxes, manholes, or at test stations as specified below. Wire shall be taped to pipe at 5-foot intervals for all piping except piping carrying combustible material. For pipe carrying combustible material, the tracer wire shall be placed in the trench directly above the pipe, maintaining 6 inches separation between the tracer wire and the pipe. Any splices in copper wire shall be made with a 3M™ DBR/Y-6 splice kit, or equal.
2. Tracer wire test stations shall be SnakePit magnetized tracer boxes by Copperhead Industries, or equal. Tracer box shall be corrosion-resistant brass wire lugs and wax pad to cover wire connection. Cover shall be color-coded according to APWA standards for fluid conveyed. Provide SnakePit Lite Duty Box in unpaved areas and Roadway Box in paved areas. Provide Rhino Triview Marker Posts, or equal, at all test stations. Provide custom decals to identify fluid in piping. The tracer wire shall be accessible at a minimum of every 500 feet along the pipeline and at horizontal bends in piping. The tracer wire shall run into and up the sides of all manholes and be secured near the casting. Test stations shall be placed as required between manholes to comply with the minimum 500-foot tracer wire accessibility requirement.
3. CONTRACTOR shall perform continuity testing of all tracer wire in the presence of RPR.

2.04 VALVES (VALVES FOR UNDERGROUND SERVICE ARE SPECIFIED IN DIVISIONS 23 AND 40)

- A. Valves shall conform to Section 40 05 00—Piping and Appurtenances.

2.05 YARD HYDRANT

A. Yard Hydrants:

1. Yard hydrants shall be the sanitary, automatic draining, freezeless, self-closing type as manufactured by Woodford Manufacturing Model S4H, Colorado Springs, Colorado, Hoeptner Products Model Executive Hydrant, Gilroy, California, or equal. Hydrant shall be provided with backflow protection that meets ASSE 1052 and be constructed and installed in accordance with ASSE 1057 standards. Hydrant shall be built for a 4-foot-bury depth and painted red.
2. Yard hydrants shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10

removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the pressure relief valves and yard hydrants once assembled. Cleaned surfaces shall then be shop-primed. Cleaned surfaces shall then be factory shop primed. Factory shop prime with one coat of Tnemec N69 or 20 HS or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all valves, hydrants, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

2.06 CONCRETE

- A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 03.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Underground Piping:
 1. Except where noted or specified, all ductile iron underground piping shall be laid in accordance with AWWA C600 or AWWA C605 with the conditions that (a) blocking shall not be used to support pipe and (b) all bends and fittings shall be restrained as specified below, and pipe joints shall be restrained in all directions from all bends and fittings to the length as specified below.
 2. For restrained pipe joints, all underground ductile iron pipe joints shall be restrained to the length listed below in all directions from all bends and fittings. All joints on yard and fire hydrant leads shall be restrained. Where wall penetrations occur at less than the length indicated below, the wall fittings shall also be restrained. Additional restraint shall be provided inside of structures as required.

MINIMUM LENGTH (IN FEET)
 RESTRAINED PIPE FROM BENDS OR FROM BENDS OR FITTINGS
 (MINIMUM 4 FEET BURY DEPTH)

Pipe Diameter	4"	6"	8"	10"	12"	16"	20"	24"
Length	54'	54'	54'	54'	66'	98'	125'	145'

3. HDPE sewer and plant drain piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
4. Except where noted or specified, reinforced concrete pipe shall be installed in accordance with ASTM C12.
5. Plumbing system shall be installed and tested in accordance with local and state plumbing code requirements and applicable portions of 2017 Ohio Plumbing Code. Where requirements conflict, the stricter standard shall apply.
6. CONTRACTOR shall excavate and lay all gravity pipe to the line and grade shown on the Drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall excavate and lay pipe to the line and grade shown on the Drawings with bell ends in the direction of laying. Water piping shall have a minimum of 4 feet of cover.

Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.

7. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense, unless CONTRACTOR can demonstrate that the pipe to be used is compatible with the resulting load applied.

PERCENTAGE BY WEIGHT PASSING

	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
1 inch	100	---	100	---
3/4 inch	90 to 100	---	90 to 100	---
1/2 inch	---	100	---	---
3/8 inch	20 to 55	90 to 100	20 to 55	100
No. 4	0 to 10	---	0 to 10	95 to 100
No. 8	0 to 5	0 to 15	0 to 5	80 to 100
No. 30	---	0 to 5	---	25 to 60
No. 100	---	---	---	5 to 20
Passing No. 200	---	---	---	2 to 10

8. Gradation No. 9, 68, or 57 conforming to the Standard Specifications for rigid pipe such as ductile iron or concrete.
9. Gradation No. 9 conforming to the Standard Specifications for flexible pipe such as HDPE.
10. Sand, as required, shall conform to Section 804.07 of the Standard Specifications.
11. CONTRACTOR shall furnish ENGINEER with a sieve analysis of the bedding material for approval prior to construction.
12. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
13. Immediately before placing the pipe, bedding shall be shaped by hand to fit the entire bottom quadrant of the pipe between bell holes. Bell holes shall be large enough to permit proper making of the joint but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding under the body of the pipe. Bedding must be tamped into place. If necessary to obtain uniform contact of the pipe with the bedding, a template shall be used.
14. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
15. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe prior to acceptance.
16. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

17. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand.
18. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on the drawings for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
19. All cover material shall be placed in maximum 6-inch layers and compacted. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 31 23 00—Excavation, Fill, Backfill and Grading.
20. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 31 23 00—Excavation, Fill, Backfill and Grading.
21. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
22. General Excavation:
 - a. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
 - b. Work shall conform to other sections of Division 31 except where modified by this section.
 - c. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
 - d. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid.
 - e. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced in accordance with Section 31 23 00—Excavation, Fill, Backfill, and Grading. Payment will also be in accordance with Section 31 23 00—Excavation, Fill, Backfill, and Grading.
 - f. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present

underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.

- g. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
 - h. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.
 - i. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
23. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
24. Yard Hydrants: Yard hydrants shall be set on a slab of concrete at least 1 cubic foot in size and against a 3-cubic-foot minimum concrete brace laying against undisturbed earth. Backfill at base of hydrant shall be 1 cubic yard of coarse gravel. It shall be the responsibility of CONTRACTOR to set the hydrants at to the proper grade. Extensions or fittings shall be provided as required.
25. Trench drains, channel, and grates shall be installed according to manufacturer's requirements. Place minimum 4 inches of concrete beneath and on each side of channels.

3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
- B. Work shall be tested as specified in this section. Unless indicated in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Underground piping shall be backfilled or properly secured to avoid damage during testing. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks. Manholes and precast reinforced concrete wet wells and appurtenances shall be free of any visible leaks. Any leakage shall be sealed by methods acceptable to OWNER, from the exterior of the manhole or

structure. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497.

D. Piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.

E. Pressure Tests:

1. Pressure tests shall be performed as required by AWWA C600, unless otherwise noted herein.
2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents and/or installation of corporations at high points in system. Presence or absence of air will be determined during pressurization of the piping system.
3. The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/D, shall be tested at the higher test pressure.
4. During performance of the hydrostatic pressure test, water main shall be subjected to a minimum pressure of at least 50% above normal working pressure with a minimum pressure 125 psi. Force main shall be tested to 200% of normal operating pressure in the main, but to no more than the pressure rating of the pipe.
5. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
6. Where connections are made to existing mains, it shall be the responsibility of CONTRACTOR to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves and restraint to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by CONTRACTOR at its expense.
7. All testing of pipelines shall proceed concurrently with installation. CONTRACTOR is advised that it may be advantageous to conduct daily preliminary testing of its Work.
8. Water from disinfection testing shall not be discharged to a stream, creek, river, storm sewer tributary thereto, or to a navigable water without first neutralizing the chlorine residual in the water and complying with local, state, and federal laws thereto.
9. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi by less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
A	15, 25	Air	"B" ⁽²⁾
ML, SCM, SE, RAS, D, RW,	10	Water	"A"

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
DEC (Gravity Flow)			
RAS (Pump Discharge) SCM, WAS, D, SCM/D	50	Water	"A"
NPW, PW	150	Water	"A"

- (1) Leakage allowance designation "A" shall mean not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for all piping except buried mechanical joint pipe. Buried mechanical joint pipe shall meet the leakage specifications of AWWA C600.
- (2) Leakage allowance Designation "B" shall mean a loss of pressure of not more than 5% during the test period.

F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

G. Infiltration/Exfiltration Tests:

1. Leakage Testing:

- a. All sanitary sewer gravity mains, drains, and those pipes designated as PSS, RW, and D shall be tested for leakage after installation of laterals and placement of backfill. Leakage testing of thermoplastic and iron sanitary sewer gravity mains shall be conducted in accordance with ASTM F1417. Testing of clay sanitary sewer mains shall be in accordance with ASTM C828. Testing for concrete sanitary sewer mains shall be in accordance with ASTM C1214. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
- b. Air and leakage testing of storm sewers will not be required.

2. Deflection Testing:

- a. All PVC pipe used for sanitary sewer shall be tested for vertical deflection. Maximum deflection after completion of backfilling shall be 5% of the inside pipe diameter. Testing shall not be started until trench backfill has been in place for 30 days. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results. Deflection shall be measured by pulling a mandrel with a vertical diameter equal to 95% of the pipe inside diameter through the line, after thoroughly flushing the lines to be tested. The testing device shall be controlled using cables at both the upstream and downstream manholes. The testing device must pass freely through the sewer without the use of unreasonable force on the control cables. Any line that will not pass the test cylinder will not be accepted until the faulty sections have been removed and replaced and the line retested.
- b. Deflection testing of thermoplastic storm sewer shall be provided in accordance with the above requirements.

H. Manhole Testing:

- 1. Sanitary sewer and process piping manholes shall be vacuum tested. A vacuum of 10 inches of mercury shall be drawn on the manhole. For a 4 foot manhole less than 20 feet deep, manhole shall hold 9-inches of mercury for at least one minute. Pipes entering the manhole shall be plugged and the seal inflated in accordance with

manufacturer's recommendations. CONTRACTOR shall provide all required test apparatus, including vacuum pump and gauges.

2. Vacuum testing of storm sewer and other manholes will not be required.

3.03 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.
- B. In accordance with the requirements of AWWA C651, at least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch.
- C. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria in accordance with Option A of Section 5.1 of AWWA C651. Copies of test results shall be submitted to OWNER and ENGINEER.
- D. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- E. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction.
- F. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

3.04 REPAIR AND RESTORATION

- A. Tree Removal: Tree removal and grubbing necessary for installing sewer, water, and other work shown shall be included in the Lump Sum Bid.
- B. Pavement Repair: Unless otherwise specified, CONTRACTOR shall replace all bituminous and concrete pavement removed or damaged during performance of the work. Concrete pavement replacement shall conform to Division 03. Bituminous pavement replacement shall conform to Division 32.
- C. Cleanup:
 1. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
 2. All areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off and cleaned up. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
 3. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

3.05 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are

approximate. Where necessary, existing piping shall be exposed before installing new piping. Any changes in pipe location or elevation shall be reviewed by ENGINEER.

- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned shall have each end plugged with concrete or nonshrink grout. Nonshrink grout shall be as specified in Division 03. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.

END OF SECTION

SECTION 33 01 31

SEWER BYPASS PUMPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Providing all materials, labor, equipment, power, and maintenance necessary to perform bypass pumping while the Work is being completed.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
 - 1. No separate payment item is included for Sewer Bypass Pumping. All costs for bypass pumping required to complete the Work shall be considered incidental to the Work and included in the cost of adjacent or related Work.
 - 2. The cost of retrieving equipment under all circumstances, including when it becomes lodged, shall be incidental to the Work.

1.02 SEQUENCING

- A. Applicable provisions of Section 01 11 00–Summary of Work govern construction sequencing.

1.03 EXISTING SYSTEM

- A. Applicable Drawings and provisions of Section 01 11 00–Summary of Work describe the existing system. At a minimum bypass pumping will be required at the following locations:
 - 1. 12-inch raw sewage pipe from MH A.
 - 2. 8-inch raw sewage pipe from MH B.
 - 3. Final Effluent to Outfall.
 - 4. RAS/WAS to Structure 20.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
 - 1. CONTRACTOR shall submit to OWNER detailed plans and descriptions outlining all provisions and precautions to be taken by CONTRACTOR regarding the handling of existing sewage flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to provide proper protection of the facilities, including protection of the access and bypass pumping locations from damage because of the discharge flows and compliance with the requirements specified in these Contract Documents. No rehabilitation shall begin until all provisions and requirements have been reviewed by OWNER.
 - 2. The Bypass Pumping plan shall include but not be limited to details of the following:
 - a. Staging areas for pumps.
 - b. Sewer plugging method and types of plugs.
 - c. Number, size, material, location, and method of installation of suction piping.

- d. Number, size, material, method of installation, and location of installation of discharge piping.
- e. Bypass pump sizes, capacity, number of each size to be on-site, and power requirements.
- f. Standby power generator size and location.
- g. Downstream discharge plan.
- h. Method of protecting discharge manholes or structures from erosion and damage.
- i. Method of noise control for each pump and/or generator.
- j. Any temporary pipe supports and anchoring required.
- k. Design plans for access to bypass pumping locations.
- l. Schedule for installation and maintenance of bypass pumping lines.
- m. Plan indicating location of bypass pumping lines.

B. Any proposed method of other flow controls shall be submitted for review by OWNER.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Applicable provisions of Section 01 60 00–Materials and Equipment govern the handling, storage, and protection of materials and equipment.

1.06 DEFINITIONS

- A. The following definitions or abbreviations apply to the Work in this Division:
 - 1. NASSCO–National Association of Sewer Service Companies.
 - 2. Mobilization–The initial process of assembling, making ready, and transporting to the Project site, the necessary materials and equipment to complete the package of Work designated by OWNER. The timetable for mobilization shall be as needed to allow for completion of the Work within the time frame required by OWNER.
 - 3. Emergency Mobilization–Mobilization within the time period indicated in the Bid to meet emergency conditions as determined by OWNER.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 SEWER BYPASS PUMPING

- A. Where required by sewage flows or inability to prevent debris from falling into the flow stream, CONTRACTOR shall bypass the sewage around the sewer sections or manholes as required to complete the Work.
- B. Precautions shall be taken when bypass pumping is required to prevent the flooding of nearby property.
- C. Under no circumstances will the diversion or dumping of raw sewage be allowed onto the streets, storm sewers, or into streams. The bypass shall be made by plugging an existing upstream manhole and pumping the sewage into a downstream manhole or adjacent sanitary sewer system. Bypass pumping shall mean the use of pumps, tanks, hoses, and

other necessary equipment to cause uninterrupted flow of sewage around the section or reach in which the Work is being accomplished.

- D. All bypass pumping operations must be attended by personnel to prevent flooding in case of pump failure. Under no conditions shall a bypass pumping operation be left unattended. All personnel for setup, operation, and supervision of the bypass pumping equipment shall be provided as necessary.
 - 1. CONTRACTOR shall be responsible for monitoring the pumps and fuel levels while in use. Daily Inspection of the pumping system, including the force main, shall be performed by the CONTRACTOR as required by OWNER. An increase in Inspection frequency may be required by OWNER dependent upon job specific conditions. CONTRACTOR shall keep a log of all inspections and provide the log at the OWNER's request.
 - 2. The bypass pumping system shall immediately notify proper personnel when a failure of the bypass pumping system occurs or a high flow level occurs. This immediate notification shall also occur when the primary system fails and the backup system automatically switches over. Assigned personnel shall be on call 24 hours a day and shall respond to the project site within one hour of the notification.
- E. All hoses and pumps shall be sized by CONTRACTOR to be of sufficient capacity to handle the existing sewage flow, plus additional flow that may occur during wet weather periods and during periods of high runoff. All equipment used in bypass pumping shall be operated and maintained in proper running condition at all times.
- F. All hose connections shall be watertight and no leakage shall be allowed to the surface. Pumping system hoses and appurtenances shall be tested prior to use in the sewer system to provide watertightness.
- G. The pumps shall be specifically designed for sewage, capable of passing 3-inch solids.
- H. CONTRACTOR shall satisfactorily demonstrate to OWNER that the bypass system works for at least the diurnal flow pattern before beginning any Work.
- I. Bypass pumping system shall be sized to convey the following flow rates:
 - 1. 12-inch flow into existing aeration tank MH-A
 - a. Diurnal Flow-141 gpm
 - b. Average Daily Flow-104 gpm
 - 2. 8-inch flow into existing aeration tank MH-B
 - a. Diurnal Flow-146 gpm
 - b. Average Daily Flow-97 gpm
 - 3. Final effluent to Outfall
 - a. Minimum Flow-0.07 mgd.
 - b. Average Flow-0.18 mgd.
 - c. Max Flow (Wet Weather)-1.08 mgd.
 - 4. RAS/WAS to Structure 20
 - a. Minimum Flow-0.09 mgd.
 - b. Average Flow-0.18 mgd.
 - c. Max Flow-0.27 mgd.
 - 5. At no time should the total pumped flow to the existing treatment processes exceed 1.35 mgd.

- J. To the extent possible, all tie-ins, replacement, or modifications Work shall be accomplished in no more than one 8-hour period. If Work required extends beyond 8-hours or weather causes higher flows in the existing system during the Work, the new Work shall be stopped and the existing system shall be placed back into service. The new Work shall be properly protected from damage. Any damage to the new Work or damage surrounding areas caused by the new Work shall be repaired or replaced at OWNER's decision by CONTRACTOR at CONTRACTOR's sole expense.
- K. CONTRACTOR shall provide all power fuel, maintenance materials, parts, and other expendables in order to maintain temporary pumping through the duration of the Work.

3.02 PROTECTION

- A. The sewers and treatment processes in the Project are operated and maintained by OWNER. CONTRACTOR shall perform the Work in such a manner that the operation of the existing sewers are not interrupted, impaired or damaged. Existing sewers and treatment processes must be maintained in operation at all times or adequate provisions provided to convey the specified flow. No CONTRACTOR operation shall impede the functions of the sewer system or treatment processes, including increasing surcharging in the system causing basement backups, disrupting treatment, or causing tank overflows. Any Work impacting the operation of OWNER's system shall be coordinated with OWNER.
- B. CONTRACTOR shall assume full responsibility for any damage to adjacent lands and buildings and to the owners or occupants thereof. CONTRACTOR shall examine adjacent lands and buildings and shall account for protection of the lands and buildings during the Work. Any damage caused shall be repaired at the expense of CONTRACTOR.
- C. CONTRACTOR shall be aware of the attractive nuisance of the Work and make provisions for mitigating any problems. See Division 01.
- D. The sewer system receives high flows from infiltration and CONTRACTOR shall take into account the impact precipitation events may have on the Work and shall schedule the Work accordingly. CONTRACTOR shall protect Work from damage caused by such events whether locally or regionally as they may impact the Work.

3.03 SEWER SERVICE

- A. It shall be CONTRACTOR's responsibility to maintain sewer service throughout the duration of the Work. When the Work is being conducted, CONTRACTOR shall maintain sewer service by use of bypass pumping as necessary. Sewer service shall be maintained to each home or business that is connected to the sewer or manhole where the Work is being conducted. All sewers shall be kept in service when work is not being performed.

3.04 USE OF PREMISES

- A. CONTRACTOR shall confine its operations, equipment and storage areas to the area of site, existing rights-of-way and easements as shown on the Drawings in which the existing sewer system and treatment processes are located unless CONTRACTOR enters into written agreements with property owners for use of lands during construction. Such agreements shall be provided to OWNER. Temporary

bypass facilities, including force main, shall not obstruct OWNER or private property owner access or operations.

END OF SECTION

SECTION 33 07 19

BURIED PIPING INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes insulation for all underground exterior piping except piping extending from a building perimeter out to 5 feet.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASTM C168–Standard Terminology Relating to Thermal Insulation.
 - 2. ASTM C272–Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 - 3. ASTM C518–Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM E96–Standard Test Methods for Water Vapor Transmission of Materials.
 - 5. ASTM C552-17–Standard Specification for Cellular Glass Thermal Insulation.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.

- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. All insulation and associated materials shall be free of asbestos.

PART 2-PRODUCTS

2.01 CLOSED CELL CELLULAR GLASS INSULATION.

- A. Acceptable manufacturers are Owens Corning FOAMGLAS, or equal.
- B. Insulation shall be cellular glass thermal insulation conforming to ASTM C552.
- C. Minimum nominal density shall be 7.18 lb/ft³.
- D. Thermal conductivity shall not exceed 0.29 btu-in/°F-hr-ft² at 75°F.
- E. Insulation shall be rated for service from -450°F to 900°F

2.02 JACKETING

- A. Underground Direct-Buried Jacketing:
 - 1. Acceptable manufacturers are Polyguard Products Insulrap No-Torch 125, Pittsburgh Corning Pittwrap SS, or equal.
 - 2. Minimum 70-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.03 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- B. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All un-insulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 FORMED POLYISOCYANURATE INSULATION INSTALLATION

- A. Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9 inches to 12 inches on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of flexible closed cell joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6 inches from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.
- B. Install per manufacturer's recommendations.
- C. Installation shall include considerations for expansion and contraction of piping.
- D. Field taper all changes in insulation thickness to provide a smooth transition for jacketing and provide coatings and sealants as recommended by the manufacturer at transition pieces.
- E. Insulation thickness shall be 1-1/2 inches.

3.03 PROTECTIVE JACKET INSTALLATION

- A. Install per manufacturer's recommendations.
- B. All adhesives and sealants shall be applied within temperature ranges established by the manufacturer.

END OF SECTION

SECTION 40 05 00

PIPING AND APPURTENANCES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All piping, valves, and appurtenances of every description except for pipe as specified in Divisions 22, 33, 43, and 46.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Applicable provisions of Section 01 33 00–Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.
- B. General arrangement drawings, including support system of 3 inches or larger interior and 3 inches or larger exterior (aboveground) ductile iron, PVC, CPVC, stainless steel and welded steel piping, shall be submitted to ENGINEER for approval. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings drawn to scale. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, supports, and valves and appurtenances. Plug valve orientation, including operator and plug orientation, shall be shown on Drawings.
- C. Grooved joint couplings and fittings shall be referred to on arrangement drawings and product submittals, and be identified by the manufacturer's listed model or series designation.
- D. Refer to Division 22 for DWV and potable water piping and valves.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.

- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER. All grooved joint couplings and fittings shall be of the same manufacturer.

2.02 PIPE AND PIPE FITTINGS

- A. Ductile Iron Piping and Fittings:
 - 1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.
 - 2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
 - 3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110 and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be cast or ductile iron. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.
 - 4. Flanged gaskets shall be minimum 1/8-inch-thick rubber "ring" gaskets, not full-faced gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerances.
 - 5. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressures and installation conditions specified or shown.
 - 6. Interior fittings shall be flanged and of ductile or cast iron. Flange fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
 - 7. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal.
 - 8. Flanged joints shall conform to AWWA C110, C111, and C115, and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron. Flanged gaskets shall be minimum 1/8-inch, full-face, rubber-ring, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. All aeration piping shall have FKM gaskets designed for a minimum of 300°F service. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown.
 - 9. Flanged bolts and nuts installed in wet wells, and other submerged locations shall be 316 stainless steel.
 - 10. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
 - 11. All ductile iron fittings shall be American, Clow, Griffin, Tyler, U.S. Pipe, or equal.
 - 12. All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field makeup flanges will be allowed unless strictly conforming to AWWA C115, with facing done after turning pipe through flange.
 - 13. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with

AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. For high temperature applications (250°F to 350°F), shop priming shall be with one coat of Tnemec Endura-Heat Primer N501, Sherwin Williams Heat-Flex Hi-Temp 500, or equal, minimum 2.0 to 3.0 mils dry film thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

14. Unless otherwise specified, piping and fittings in manholes and wet wells shall be as furnished above for exterior exposed and interior piping.
15. All ductile iron piping and fittings designated A (Air) shall be unlined and shall receive exterior coating as specified above.

B. Copper Piping:

1. Copper piping shall conform to the requirements of ASTM B88.
2. All interior or aboveground non-potable water supply piping smaller than 3 inches shall be Type K hard copper. Fittings shall conform to ANSI B16.22 wrought copper and be soldered or sweated on. No lead-based solder may be used. Piping shall run exposed in buildings, except in finished areas.
3. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
4. Pump vent and drain lines, pressure gauge and other small-diameter interior piping shall be rigid, Type K hard copper. An ample number of unions shall be provided for disassembling.

2.03 VALVES

A. Plug Valves:

1. Shutoff valves in ductile iron lines containing wastewater and all sludge (including RAS and WAS) lines, scum lines, and drainage lines, shall be DeZURIK Series PEF 100% port Eccentric, or equal. Shutoff valves in sample lines and 2 1/2 inches or smaller air piping shall be DeZURIK PEC Eccentric, Val-Matic Cam-Centric Series, or equal.
2. Eccentric-type valves shall be nonlubricated rectangular-ported with resilient faced plugs and end connections as shown on the Drawings. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 100% (PEF) through 20 inches of full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Valve bonnets shall be of the same material as the body. Resilient plug facings shall be chloroprene or Buna-N, suitable for use with wastewater. The valve shall be oriented with the shaft horizontal, seat upstream, and plug above flow stream when open.
3. Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals on both upper and lower bearing journals that comply with the latest edition of AWWA C507 and C504. All valves except for valves in buried or digester gas service shall include

grease fittings on upper and lower journals. Bodies of 3-inch and larger valves shall be furnished with a minimum 1/8-inch-thick machined smooth-welded overlay seat of not less than 90% nickel. Seat area shall be raised surface completely covered with weld so that the plug face contacts only nickel. Sprayed or screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type using a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in both the open and closed position. For submerged service, or in valve manholes, valve vaults, or underground utility structures, valves shall have stainless steel bolts.

4. The design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of Buna-N vee-type packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever-operated valves, the plug position retention friction device shall consist of an adjustable phenolic cone that clamps on the plug shaft or a moly sheath. Metal-to-metal friction devices shall not be acceptable.
5. Valve working pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 inches through 24 inches. Valves shall provide drip-tight shutoff up to the full pressure rating.
6. Extension stems and other accessories shall be provided as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200. Provide floor stands as shown on drawings.
7. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Except as noted below, valve interior shall be shop-primed and finish painted with epoxy painting system or fusion-bonded epoxy system as specified above. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

B. Check Valves:

1. Except where noted, check valves in ductile iron lines carrying liquid shall be Series 41 by AVK (lever and weight), or equal, 150 psi, ductile iron or iron body, bronze or stainless trimmed, swing check. Additional weights shall be used if necessary to stop slamming.
2. Air Check Valves: Check valves in ductile iron or stainless steel lines carrying air shall be short-body Technocheck, Style 5102, US Valve Model 09-2-0, or equal, flanged end, 125 psi cast iron body, aluminum internals, check valves. Sealing member shall be silicone suitable for air under test pressure specified and temperature of 500°F.
3. Miscellaneous:
 - a. Check valves in other than ductile iron, cast iron, PVC, polyethylene, or compressed air lines shall be Class 150, Milwaukee Valve 510, Nibco T-433, or equal, screwed end, bronze, bronze disc, swing check for water and air.
 - b. Check valves in PVC lines shall be ball check type of PVC construction.
 - c. Check valves in polyethylene lines shall be of polypropylene construction.
 - d. Check valves in compressed air lines 3 inches or smaller shall be horizontal lift check valves, Class 150, Crane No. 27TF, or equal. Valves shall have threaded ends, PTFE disc, union cap, and bronze body and cap.
4. Asphaltic varnish and coal tar coating are not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

C. Butterfly Valves:

1. Except as otherwise specified, shutoff valves in air lines 3 inches or larger shall be DeZURIK BHP, or equal, 150 psi, A516, carbon steel, PTFE/titanium-resilient seat suitable for air at a temperature of 450°F, wafer butterfly valves. Valves 6 inches and smaller shall have ten-position levers.
2. Extension stems and other accessories shall be provided as shown on the Drawings and as required to allow easy access for operation of valves within reach from walkways or other access points. Extend operators to at least 24 inches above walkways. Extension stems for ten-position lever butterfly valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with 2-inch operating nut or other mechanism as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of stem shall be limited to an l/r ratio of 200.
3. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be epoxy-coated. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process

as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. For high temperature applications (250°F to 350°F), shop priming shall be with one coat of Tnemec Endura-Heat Primer 1501, Sherwin Williams Heat-Flex Hi-Temp 500, or equal, minimum 2.0 to 3.0 mils dry film thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

- D. Plug Drain Valve: Plug drain valves shall be as manufactured by RW Gate Company, Troy Valve, or equal. Valve sizing and travel shall be as shown on the Contract Drawings. The mud valve shall be pipe flange mounted unless otherwise shown. Valves shall consist of non-rising threaded stems and wall bracket mounted 2-inch operating nuts or floorstand mounted handwheels as shown on the Drawings. The threaded portion of the stem shall have a minimum diameter of 1 1/2 inches and shall have machine rolled, full depth Acme threads. Valves shall be constructed of 316 stainless steel throughout, including mud valve body, stem, extension stem, wall bracket, floorstand, anchors bolts and assembly hardware. Valve body shall be cast iron. The stem, stem nut, and seat shall be bronze. Painting and surface preparation shall be as specified for plug valves. A bronze thrust collar and bronze lift nut will be provided as part of the assembly. The seal shall be mounted on the movable cover and shall be minimum 3/8-inch thick, neoprene or EPDM.
- E. Gate Valves:
1. Shutoff valves in potable and non-potable water lines 3-inch diameter and larger shall be AWWA C509, cast iron, resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
 2. Underground valves shall have extended stem, cast iron telescopic valve box, and key.
 3. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats) as specified in Division 09.
- F. Miscellaneous Valves, Strainers, Hose Bibs, and Valve Boxes:
1. Shutoff valves for all piping except for piping covered by Division 22, lines smaller than 2 1/2 inches shall be Nibco T-585 (threaded), Nibco S-585 (solder joint), or equal, full port ball valves. Provide extended stems for valve operators installed with insulated pipe.
 2. As shown on the Drawings, supply curb stop shutoff valves for buried PW and NPW piping, 2 inches and smaller. Curb stops must meet AWWA C800. Curb stops in NPW yard piping shall be Ford B44-777M ball valves with Minneapolis-type curb boxes complete with lid and 6-foot stationary rod, or equal. Curb stop near disinfection facilities for 1-inch NPW service to building shall be Ford B71-444M ball valve with a Minneapolis-type curb box complete with lid and 6-foot stationary rod, or equal. Provide two 4-foot shutoff keys to operate valves. Lids shall have the word "WATER" cast into the top of the covers or shall be blank. Curb stops shall be placed on minimum 3 cubic feet of concrete placed on undisturbed earth.
 3. Hose Bibs:
 - a. Hose bibs providing non-potable water shall be provided with a removable key handle.

- b. Exterior hose valves shall be Woodford Model 65, Watts, or equal, freezeless wall hydrants with integral ASSE 1019 backflow preventer outlet, permanent valve seat, and brushed chrome exterior face with 3/4-inch outlet garden hose threads and 3/4-inch inlet. Provide loose key operator with each exterior hose bib. Provide round or square box recessed enclosure with locking door for the hose bib. CONTRACTOR shall coordinate wall thickness with recessed enclosure depth.
 - c. Interior hose valves shall be Woodford Model 24, Watts, or equal. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet. Interior hose valves shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal. Provide metal handle and chrome plate finish. Provide loose key with each faucet.
 4. Valves in NPW piping used for fluid control as shown on the Drawings shall be Nibco, or equal, globe valves rated for 200 psi WOG. Valves shall be bronze with TFE disc.
 5. Valve Boxes:
 - a. Valve boxes shall be provided for all buried valves.
 - b. Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
 - c. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
 - d. Valve box alignment devices: All valves shall be supplied with a gate valve adaptor as manufactured by Adaptor, Inc., or equal. All adaptors shall have a metal frame and be supplied with a 3/4-inch rubber gasket. All adaptors shall be sized to fit the brand of valve being supplied.
 6. Shutoff valves in potable water lines smaller than 1 inch shall be Milwaukee UP105 (threaded), or Milwaukee UP115 (solder joint), Nibco T-113-LF (threaded), or Nibco S-113-LF (solder joint), or equal, bronze 300 psi gate valves.

2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.
- B. Non-Potable Water Caution Signs: Place non-potable water signs permanently mounted at every hose bib, hydrant, or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" or similar standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners. At yard hydrant, provide post-mounted signs on steel U-channel posts.

C. Rubber Expansion Joints:

1. Rubber expansion joints shall be furnished and installed where shown on the Drawings and where required to eliminate vibration from equipment to piping. Expansion joints shall be the single filled-arch type as manufactured by the Mercer Rubber Company, Series Style 451 or 500; General Rubber Corporation; or equal. Unless otherwise specified, expansion joints shall be provided complete with control rods and rubber washers as required. Control rods shall be provided to prevent over-stress on coupling at a minimum of twice the system test pressure. The number and size of the control rods shall be sufficient for twice the test pressure, two rods minimum. Control rods are not required on suction side of aeration blowers. Expansion joints shall have integral duck and rubber flange with split backup rings and have a minimum rated working pressure of 150 psi and 20 inches Hg vacuum. Joints shall be provided with higher rated working pressures, if required to meet specified test pressures. Joints shall have a nominal laying length of 6 inches for joints sized up to 8 inches in diameter, 8 inches for joints sized up to 20 inches in diameter, and 10 inches for joints sized up to 36 inches in diameter. Tube and cover shall be of butyl rubber.
2. Expansion joints on aeration piping shall be designed for 275°F temperature and shall be Mercer 501EE (EPDM), or equal. Expansion joints on aeration piping shall be designed for 350 degree temperature and shall be Mercer HT501, or equal. The expansion joint shall be made of EPDM [Teflon and EPDM (high temp)] and shall have a 55 psi working pressure with flanged ends. Unless otherwise specified, expansion joints shall be provided complete with control rods and rubber washers as required. Control rods shall be provided to prevent over-stress on coupling at a minimum of twice the system test pressure. The number and size of the control rods shall be sufficient for twice the test pressure, two rods minimum. Control rods are not required on suction side of aeration blowers.

D. Aeration Piping Couplings: Except as otherwise specified or shown on the Drawings, couplings on exterior exposed aeration piping shall be Dresser Style 38, Smith Blair 411, or equal. The couplings shall have Viton gaskets and shall allow a minimum of 1/4-inch expansion. If two or more couplings are used to provide expansion compensation, provide a harness welded to each side of the couplings, and distribute the expansion evenly over the couplings.

E. Pipe Coupling: Pipe couplings identified on the Drawings shall be Dresser Type 38, Smith Blair 411, or equal, steel coupling. CONTRACTOR shall provide tie ears and tension ties where necessary to restrain pipe.

F. Tension Ties: All tension ties, rod ties, and control rods shall be provided to resist a minimum 150 psi 250 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts shall be carbon alloy steel conforming to ASTM A563, and washers shall be hardened steel conforming to ASTM F436. Rods shall be ASTM A36 steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
4-10	4	5/8	4	5/8

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8
36	8	1 1/4	8	1 1/2
42	12	1 1/8	12	1 1/2
48	11	1 3/8	22	1 1/4
54	11	1 1/2	22	1 3/8

- G. Floor Boxes: Provide floor boxes in concrete floors or slabs and as shown on the Drawings. Floor boxes shall be Neenah R-7506-B, or equal. CONTRACTOR shall verify that all floor boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.
- H. Mechanical Seals: Mechanical seals shall be 316 stainless steel Link Seal, Innerlynx by APS, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.
- I. Pressure Gauges: Provide a pressure gauge on each new pump discharge piping in the valve pit discharge of all pumps. Pressure gauges shall be Ashcroft, or equal, and shall have scale in psi with a maximum range equal to twice the normal operating pressure indicated in the submersible pump equipment specifications. Gauges shall have 4-inch minimum diameter stainless steel case, shall be connected to a mineral-oil filled diaphragm housing to separate the gauge from liquid in discharge line, and shall have accuracy of $\pm 1\%$. Provide isolation valve and union at connection to pipe to allow the gauges to be removed while the line is under pressure. Gauges shall be mounted to permit pressure readings from above without entering the valve pit.
- J. Service Saddle: Service saddles shall have a ductile iron body per ASTM A536 and have two carbon steel bales. Bales, washers, and nuts shall be electro-galvanized with dichromate seal. Gasket shall be of Nitrile rubber and NSF61 listed. Saddle shall be Smith-Blair, Style 313, or equal.
- K. Swivel Joint: Swivel joint on Structure 70 decant line shall be Dixon Valve Model 0450-640F, 6-inch stainless steel (Part No. 640FGXFGSS21220). The swivel joint shall be a 6-inch pipe diameter, Style 40, made of 316 stainless steel. Manufacturer shall provide weighted collar for stainless steel pipe to prevent buoyancy.
- L. Air Flow Meter and Pressure Gauge: Air lines at the Aeration Tank (STR 20) shall have an orifice flow meter and pressure gauge. Orifice plate flow meter shall be model OP-J-2, 304SS orifice plate, 4" line size, 2" bore, as provided by Dwyer. The orifice plate will be

paired with a pressure gauge that does not require electrical connections. Pressure gauge shall be 2SQRT, (19.51 " WC 295 SCFM) as provided by Dwyer. Flow meter and gauge shall be installed on 4-inch air pipe at location shown on the Drawings.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 INSTALLATION

- A. Interior or Exposed Piping:
 - 1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the Drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Type 316L stainless steel supports and fasteners shall be used in submerged locations, tanks, wet wells, screening, or as indicated. Piping shall be adequately supported and braced to resist thrust at bends, rubber expansion joints, and joints. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured wherever needed or shown on the Drawings.
 - 2. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
 - 3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
 - 4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
 - 5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10

removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, Tnemec 140-1255 Beige Pota-Pox, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

6. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Copper Tubing		Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft		
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4
2	8	10		4
2 1/2	9	10		4
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10
18			10	10
20			10	
24			10	
30			10	
36			10	
42			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and

manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Provide saddles or shields under or around piping between hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under aeration stainless steel piping to prevent indentation of piping from the support or clamp.
9. Spacing for stainless steel air piping supports shall be a maximum of 16 feet for 6-inch diameter and above piping. Pipe slides, Anvil Figure 257, Type 3, B-line, or equal, in stainless steel shall be used on pipe support brackets where movement due to pipe expansion is anticipated. Expansion joints shall be used to prevent excessive pipe stress. Clamps or supports in contact with the stainless steel piping or as indicated shall be stainless steel.
10. Anchored supports shall include a stainless steel U-bolt and nuts bolted to the wall bracket.
11. Aeration piping in tanks or channels shall be supported by stainless steel brackets. The brackets shall be Anvil Figure 199 No. 3, B-line, or equal, and shall have a load rating of 3,000 pounds minimum. Provide stainless steel anchor bolts. Aeration piping to the channel aeration system shall be supported on the top of the wall by stainless steel pipe clamps, Anvil Figure 103, or equal.
12. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
13. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the Drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
14. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
15. Valves shall be located on all branches of water supply lines where shown on the drawings. Position valves to facilitate access and operation.
16. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
17. All glass-lined, PVC, and stainless steel aeration piping shall be protected from dust and debris deposits on the inside of the pipe during storage and installation. Protection shall

be by plastic film or coated paper banded over the pipe ends to be removed just prior to installation. Any foreign matter shall be removed from the pipe interior at the time of installation.

18. On clear liquids and on lines carrying solids where neither side of the pipeline drains, the valve shall be positioned so that the seat end of the valve is downstream of the shutoff pressure. The highest pressure should always be on the back side of the plug, except for a valve installed in a vertical pipe. On sludge or slurry lines where one side of the line normally drains, it is preferential to install the seat end of the valve upstream so that the valve cavity drains empty. Where possible in horizontal pipelines, the valve shall be installed with the axis of the plug horizontal and the plug in the top of the valve when in the open position. In vertical pipelines carrying sludge or slurries, the seat end shall be at the top of the valve. Valve installation shall be in accordance with manufacturer's requirements.
19. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by ENGINEER.
20. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the Drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the Drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.

B. Wall and Other Pipe Penetrations:

1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping. The sleeve diameter shall not exceed the pipe o.d. plus 2 inches (or the pipe flange o.d. plus 1 inch, as applicable). If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. Steel sleeves shall be prepared, primed, and painted in accordance with Division 09 prior to placement in between concrete forms. Steel sleeves shall receive touch-up paint prior to placing forms. In lieu of steel sleeves, HDPE Infinity Wall Sleeves or Gal-vo-plast Wall Sleeves by APS, or equal. Each sleeve shall include integral waterstop. CONTRACTOR shall install sleeves in accordance with manufacturer's recommendation and no sleeve distortion or deflection will be allowed. For copper pipe, provide an elastomeric sleeve on pipe where it passes through walls or slabs.
3. Where plain wall pipes are shown or indicated on the Drawings, CONTRACTOR may substitute a flanged end wall pipe, if desired, for the purposes of pressure testing specified herein.
4. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class I, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.

5. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter flashing.
 6. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the Drawings. The annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces) or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with ENGINEER to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, to achieve a watertight seal.
 7. Where pipes pass through fire-rated walls, floors, ceilings, or other assemblies, the required firestopping materials shall be provided. Refer to Section 07 84 00—Firestopping for requirements.
 8. Nonshrink grout shall be as specified in Division 03.
 9. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without notifying ENGINEER. All openings for pipe work shall be neatly patched in a workmanlike manner.
 10. Rough openings in wet well walls shall be provided to install force main discharge piping. Opening shall be minimum necessary to provide for nominal adjustments of pipe installation to eliminate the need for special flanges or sleeves in the wet well to allow for laying length adjustments. After piping is installed and properly supported, opening shall be filled with nonshrink grout formed to the wall surfaces.
- C. Cleaning and Disinfection: All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. Work shall be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.

- E. Gauges used for testing shall have increments as follows:
1. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 3. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
- F. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids, such as SCM/WAS, shall be tested at the higher test pressure.

Fluid Abbreviation	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
A	15, 25	Air	"B" ⁽²⁾
ML, PI, SCM, SE, RAS (Gravity Flow), RW, FE, D, OF, PSS	10	Water	"A" ⁽¹⁾
D, RAS (Pump Discharge), WAS, SCM/D, SCM, DEC	50	Water	"A" ⁽¹⁾
NPW, PW	150	Water	"A" ⁽¹⁾

¹ Leakage allowance Designation "A" shall mean zero leakage.

² Leakage allowance Designation "B" shall mean a loss of pressure of not more than 5% during the test period.

- G. See Section 22 13 00–Facility Sanitary Sewerage for testing of building drainage systems.
- H. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

3.04 DEMOLITION

- A. All piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.

3.05 CLEANING AND DISINFECTION

- A. All potable water equipment and materials shall be clean before installation. CONTRACTOR shall disinfect potable water systems and flush the system before it is put on line.
- B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

- C. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- D. All surplus material, tools, and equipment shall be removed and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 40 05 53

IDENTIFICATION FOR PROCESS INTERCONNECTIONS PIPING AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, valve, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the drawings. CONTRACTOR shall identify including, but not limited to, all equipment, valves, piping, ductwork, dampers, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Schedule:
 - 1. Submit valve schedule complete with building number, room number, valve tag numbering system, valve function, valve type, area served, year installed, manufacturer, model number, size, rated pressure, temperature rating and normal position.
 - 2. Valve schedule shall be developed using OWNER's valve naming convention. Provide OWNER with electronic version (Microsoft Excel) of the final approved valve schedule at or before Project closeout.
 - 3. Submit equipment schedule complete with building number, room number, equipment tag numbering system, equipment function, equipment type, area served, year installed, manufacturer, model number, size, emergency power (Y or N) and rated capacity.

1.03 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirement and standards addressed within the following references:
 - 1. ASME A13.1–Scheme for the Identification of Piping Systems.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Type “A” Nameplates:

Use: Fans.

Air handling units.

Unit heaters, etc.

Size: 4-inch by 6-inch.

Material: 3-layer laminated Micarta.

Background Color: Black.

Character Color: White.

Character Size: 1 1/4 inches.
Engraving: Equipment label.
Mounting Location: Equipment–Top wireway.

B. Type “B” Nameplates:

Use: Identify control stations, thermostats, etc.
Size: 3/8-inch by 2-inch.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 1/8 inch.
Engraving: Control station number or equipment controlled.
Mounting Location: Device front at top.

C. Type “C” Nameplates:

Use: Identify function of process and HVAC control panels.
Size: 1-inch by 2-inch.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 1/2 inch.
Engraving: Control panel function.
Mounting Location: Panel face as requested by ENGINEER.

D. Type “D” Nameplates:

Use: Control panels.
Size: As necessary.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 3/16 inch.
Engraving: Operating function.
Mounting Location: As requested by ENGINEER.

E. Type “E” Nameplates:

Use: Description of control panel function.
Size: As necessary.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 3/16 inch.
Engraving: Operating function.
Mounting Location: As requested by ENGINEER.

F. Type “F” Nameplates:

Use: Operator instructions.
Size: As necessary.
Material: 3-layer laminated Micarta.
Background Color: Yellow.
Character Color: Black.

Character Size: 3/16 inch.
Engraving and Mounting Location: As requested by ENGINEER.

G. Type "G" Nameplates:

Use: All equipment not specifically mentioned above.
Size: As necessary.
Material: 3-layer laminated Micarta.
Background Color: Black.
Character Color: White.
Character Size: 3/16 inch.
Engraving and Mounting Location: As requested by ENGINEER.

2.02 LABELING TAGS

A. Labeling Tags:

Use: Field-mounted devices (Limit switches, etc.).
Size: 1-inch by 3-inch.
Material: 1/32-inch-thick stainless steel.
Character Size: 1/4 inch.
Engraving: As requested by ENGINEER.

B. Valve Tags:

1. All new valves shall be tagged. All slide gates and downward opening weirs shall also be tagged. CONTRACTOR shall provide on valves, engraved 2 1/2-inch by 2 1/2-inch plastic laminated tags, Seton "Setonply Series M4550-H," or equal. Nomenclature for tagging (letters and numbers) will be provided by ENGINEER. Colors will be selected by OWNER. CONTRACTOR shall affix tags to valves with Brady 38091, or equal, stainless steel wire and Brady 38090, or equal, zinc wire clamps.
2. Valve tags shall be fastened next to valve box cover on valve manholes with stainless steel fasteners. Each stop plate and slide gate and each stop plate and slide gate grooves shall both be labeled with tags using stainless steel fasteners.

2.03 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.
- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.04 PIPE MARKERS

- A. Manufacturers: Marking Systems, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.

- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels are not acceptable. Provide lettering in accordance with table below.

PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4
8 inch to 10 inch	24	2 1/2
Over 10 inch	32	3 1/2

PART 3-EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.
- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.
- G. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.

- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer’s instructions.
- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on drawings.
- D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.
- E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- F. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Wastewater Lines	
Sewage (except sanitary drain, waste, and vent piping provided under Division 22)	Green/White
Sludge	Green/White
Water Lines	
Raw	Green/White
Settled or clarified	Green/White

END OF SECTION

SECTION 40 05 59.23

SLIDE GATES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation slide gates and weir gates as listed below and indicated. Slide gates and weir gates shall be complete with gate, guides, framing, operator, and other components as required to make a complete system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application:
 - 1. Slide gates and weir gates shall be suitable for use in wastewater streams that, in addition, may contain iron salts, polymers, chlorine solution, or sulfur dioxide solutions.
 - 2. Weir gates shall be downward acting and shall form a sharp-crested weir. Weir gates shall be used in modulating service to control flow rates.

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Fabricated stainless steel slide gates and weir gates shall be Whipps, Inc. of Athol, Massachusetts, or equal.

2.02 GATE CONSTRUCTION

- A. The slide gates shown on the drawings and listed in the specifications shall conform to the latest edition of the AWWA Standard for Slide Gates, AWWA C561, and to the following detailed specifications.
- B. Disc: The gate disc shall consist of a flat plate reinforced with structural or formed members welded to the plate. The disc shall be designed to limit the deflection of the gate to 1/360 of its span or 1/16 inch, whichever is less, under design head. The working design stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of

the material. All disc components shall have a minimum material thickness of 1/4 inch. Provide ultra-high molecular weight polymer bearing bars on each side of gate.

- C. Frame: The gate frame shall consist of guides, invert member, and operator yoke welded or bolted together to form a rigid one-piece frame. The guides shall conform to AWWA C561 requirements and shall have a minimum material thickness of 1/4 inch. The guide slot shall engage the disc plate a minimum of 1 inch. The invert member shall be an angle, channel, or formed shape welded to the bottom of the guide to form a flush surface and to meet with the disc seal. For self-contained gates, the yoke members shall be designed to limit the deflection to 1/360 of its span. The working stresses shall not exceed the lesser of 40% of the yield strength or 25% of the ultimate strength of the material and shall be arranged to permit removing the disc from the frame.
- D. Seals: Self-adjusting UHMW seals shall be attached to the frame if necessary so that leakage shall not exceed 0.01 gpm per foot of seal perimeter of the maximum head in the seating and unseating head condition.
- E. Stems: Stems shall be 304 stainless steel and shall have a minimum diameter of 1 1/2 inches. Stem threads shall be Acme type. Stems shall be designed to transmit in compression a minimum of two times the rated output of the hoist at 40 pounds effort on the crank or handwheel. The L/r ratio of the unsupported stem shall not exceed 200. Stem guides, where required to limit the unsupported stem length, shall be bronze or UHMW bushed. All gates having widths greater than two times their height shall be provided with two lifting devices connected by a tandem shaft for simultaneous operation.
- F. Stem Covers: Rising stem gates shall be provided with clear butyrate or Lexan stem covers to provide indication of gate position, permit inspection of the stem threads, and to protect the stem from contamination. The stem cover shall be constructed of clear rigid butyrate or Lexan. Vent holes shall be provided to prevent condensation.
- G. Provide a horizontal member at 21 inches above the operating floor where handrailing is interrupted by the slide gate.
- H. All gates shall be shipped and delivered to the project site fully assembled unless CONTRACTOR requests other arrangements.
- I. All gates shall be provided with UHMW seats on the upstream and downstream sides of the disc to prevent metal-to-metal contact between the disc and the frame.

2.03 MATERIALS

- A. Slide or weir gate components shall be 304 stainless steel unless otherwise indicated. All welds and weld burn shall be sandblasted or passivated at the factory to provide a clean, uniform finish. If sand blasting is used, the entire slide and entire frame shall be sandblasted to provide a uniform finish. Self-adjusting UHMWPE seat/seals shall conform to ASTM D4020.

2.04 MANUAL OPERATORS

- A. Unless otherwise specified, operation of the gate shall be by an antifriction handwheel bench stand or by crank operation through right angle bevel gears as shown on the drawings. Maximum effort shall not exceed 40 pounds on handwheel or crank to raise gate under full

operating head. The lift mechanism shall be capable of withstanding, without damage, a handwheel or crank effort of 200 pounds. Bench stand shall be minimum of 36 inches above operating floor. Where possible, the bench stand shall be 42 inches above the operating floor where the gate interrupts handrailing. If the bench stand must be higher to allow operation of the gate, provide a horizontal member across the yoke at 42 inches above the operating floor. The member shall meet OSHA strength requirements for guardrail.

- B. A suitable side-mount operator system shall be provided where the bench stand is located over 48 inches above the operating floor. System shall include right angle bevel gear boxes, stainless steel shafting, and flexible couplings as required for operation 36 inches above the operating floor.
- C. The hoist nut shall be manganese bronze conforming to ASTM B584 C86500. The hoist nut shall be supported on roller bearings. The hoist shall be outfitted with a stainless steel pinion shaft and the pinion shaft shall be supported by roller or ball bearings. A 2-inch-square nut shall be provided on the pinion shaft to allow operation by a portable electric operator. A lubrication fitting shall be provided for lubrication of the hoist bearings without disassembly of the hoist. Suitable seals shall be provided to prevent entry of foreign matter. The direction of handwheel or crank rotation to open the gate shall be clearly and permanently marked on the hoist. Where the actuators will be interconnected, it shall be by a flexible coupling and stainless steel shaft or extruded aluminum tubing with stainless steel hardware.

2.05 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample strength for intended service. Provide anchor bolts in accordance with Section 05 56 00—Anchor Bolts and Post-Installed Anchors.

2.06 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop prime with one coat of Tnemec N69 or N140, Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Color of primer should be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finish-painted using the manufacturer's standard paint system for the specified application. Touch-up paint shall be provided by manufacturer.
- B. Provide mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale in the factory. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and frame shall be bead-blasted.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training.
- B. A minimum of one trip and two days on site shall be provided for startup and training services.

END OF SECTION

SECTION 40 41 00

HEAT TRACE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation heat tracing. The heat-tracing cable and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM 2633–Standard Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable.
- B. IEC 216-1–Guide for determination of thermal endurance properties of electrical insulating materials.
- C. UL 746B–Standard for Polymeric Materials–Long Term Property Evaluations.

1.03 SUBMITTALS

- A. Submit shop drawings, product data, and design calculations in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawings shall include plan drawing(s) showing each heat-trace circuit. Include a bill of material identifying all components and material for each circuit.
- C. Provide product data on heating cables, end terminations, power connections, thermostats, and all accessories.
- D. Provide design calculations showing the following as a minimum:
 - 1. Circuit identification number.
 - 2. Pipe temperature to be maintained.
 - 3. Thermostat type and quantity.
 - 4. Line size and insulation type.
 - 5. Heat loss for valves, pipes and supports.
 - 6. Amount and type of heating cable required, as well as number of circuits required.
 - 7. Areas of pipe where spiral wrapping of heating cable is required.
 - 8. Heating cable service voltage.
 - 9. Heating cable power output required to maintain the required pipe temperature.
 - 10. Ambient temperature used in above calculations.
 - 11. Circuit breaker sizing and quantity.

1.04 QUALITY ASSURANCE

- A. Electrical components must be listed and labeled as defined in NFPA 70, Article 100.
- B. All components shall be listed by Underwriters Laboratories.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. nVent/Raychem.
- B. Chromalox.
- C. Substitutions: Under provision of the General Conditions.
- D. The drawings and specifications were prepared based on Prentice. CONTRACTOR shall include in the Bid, and shall be responsible for, the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. This shall include equal manufacturers specified above. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 SELF-REGULATING HEATING CABLES

- A. Freeze Protection:
 - 1. The cable shall vary its power output relative to the temperature of the surface of the pipe or vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
 - 2. The cable shall have a useful life of 20 years or more with continuous power including:
 - a. Seventy-five percent of nominal power after 20 years of operation at maximum continuous exposure temperature.
 - b. Ninety percent of nominal power after 1,000 hours of operation at intermittent exposure temperature.
 - 3. The cable shall consist of two 16 AWG nickel-plated copper bus wires embedded in a self-regulating conductive core with a modified polyolefin jacket (cable inner jacket). The cable shall be suitable for use on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) of T6 without use of thermostats.
 - 4. The cable inner jacket shall be covered with a tinned copper braid with a resistance less than the heating cable bus wire resistance. The braid shall be protected from chemical attack and mechanical abuse by a polyolefin (for environments where cable will be exposed to aqueous inorganic chemicals) or fluoropolymer (for environments where cable will be exposed to organic chemicals or corrosives) jacket.
 - 5. Each circuit shall have a 30 mA ground fault protection device with a nominal 100 ms response time.
 - 6. The cable shall be supplied as shown on the drawings.
 - 7. The cable shall not have an increasing power output after being reenergized after exposure to 350°F for 30 minutes while energized.
 - 8. The cable shall be suitable for use with 120 Vac, single-phase, 60 Hz, supply voltage.

2.03 CONTROLS

- A. Local: Mechanical Thermostat shall be a fluid filled (silicone) remote bulb and capillary type with an adjustable setpoint between 15°F and 140°F. Bulb and capillary shall be constructed of 300 series stainless steel. Thermostat and remote bulb/capillary shall be suitable for installation in ambient temperatures of -40°F to +160°F. Enclosure shall be NEMA 4X, polyurethane-coated cast aluminum with stainless steel hardware and be equipped with at least one 3/4-inch NPT conduit entry. The thermostat shall have a 22 amp rating at 125/250/480 VAC, open on rise SPST switch. Coordinate with cable manufacturer on make and model of thermostat.

2.04 ACCESSORIES AND COMPONENTS

- A. Manufacturer-recommended installation tape (glass or aluminum) shall be provided depending on pipe type and installation environment.
- B. Heat-trace labels shall be manufacturer's standard material and size. Labels shall clearly include the wording "Electric Heat Tracing."
- C. Pipe straps shall be stainless steel and sized for the pipes on which they will be used. One size fits all pipe straps are not acceptable.
- D. Power connections shall be specifically designed for the heating cable being supplied and be from the same manufacturer as the heating cable. Power connections shall include NEMA 4X thermoplastic junction box with indicating light, stand, core sealer, and all accessories for making the connection from standard single conductor branch cables to the heat trace cable. Stand shall provide enough distance between the process pipe and the junction box to accommodate up to 4 inches of thermal pipe insulation. Terminations shall be rated for a maximum operating voltage of 480 VAC.
- E. Splice kits shall be specifically designed for the heating cable being supplied and be from the same manufacturer as the heating cable. Splice kits shall include splice housing, sealing grommets, core sealers and all accessories for making a cold-applied, low-profile, in-line splice of heating cable. Completed splice shall provide NEMA 4X protection for the completed splice. Splice shall be rated for operating voltage and required current of the cable being spliced.
- F. End seals shall be specifically designed for the heating cable being supplied and be from the same manufacturer as the heating cable. End seals shall be above-insulation cold-applied type with indicating light. End seals shall project through the thermal insulation on the process pipe. End seals shall be reenterable. End seal stand shall provide enough distance between the process pipe and the seal to accommodate up to 4 inches of thermal insulation between the process pipe and the seal. End seal shall be rated for the operating voltage of the cable being sealed.
- G. Brackets for mounting thermostats on process pipe shall be stainless steel and be equipped with stainless steel installation hardware.

PART 3-EXECUTION

3.01 SYSTEM DESIGN

- A. The heat trace system shown on the drawings is diagrammatic and is intended only to show the process piping that must be heat traced. Heat trace system supplier shall use the information shown on the drawings to prepare plan drawings showing all system components such as thermostats, power connections, end seals, etc., for use by CONTRACTOR.
- B. Provide design calculations showing the following as a minimum:
 - 1. Circuit identification number.
 - 2. Pipe temperature to be maintained.
 - 3. Thermostat type and quantity.
 - 4. Line size and insulation type.
 - 5. Heat loss for valves, pipes, and supports.
 - 6. Amount and type of heating cable required, as well as number of circuits required.
 - 7. Areas of pipe where spiral wrapping of heating cable is required.
 - 8. Heating cable service voltage.
 - 9. Heating cable power output required to maintain the required pipe temperature.
 - 10. Ambient temperature used in above calculations.
 - 11. Circuit breaker sizing and quantity.

3.02 INSTALLATION

- A. Install all heat-tracing cable and appurtenances in accordance with manufacturer's recommendations.
- B. For process pipes 4 inches and larger, local thermostats shall be wall-, stand-, or bracket-mounted. For process pipes smaller than 4 inches, local thermostats shall be wall- or stand-mounted.
- C. Coordinate installation with Division 20 contractor and install heat tracing prior to installation of HVAC Insulation. See Section 20 07 19-Piping Insulation for Plumbing, and HVAC.
- D. All cables shall be protected from damage during construction.
- E. Protect cable ends from chemicals, mechanical damage, and moisture by means of a manufacturer-approved and provided end seal.
- F. Install heating cable to cold lead connections in accessible locations.
- G. Provide heat-trace labels located on the outside of the mechanical insulation on the pipe. Labels shall be applied every 10 feet, alternating sides of the pipe.
- H. Power connections, splice connections, tee connections, and end seals shall be installed per manufacturer's installation requirements. All terminations must be made abovegrade in an accessible location.

3.03 TESTING

- A. Factory testing shall include all testing required by the latest edition of IEEE 515 and manufacturer's standard testing.
- B. Perform the following testing by a licensed electrician after installation, but prior to installation of insulation or other coverings:
 - 1. Test continuity prior to energizing.
 - 2. Test insulation resistance in cables before energizing per manufacturer's instructions. Testing shall be done with a 2500 VDC megger according to IEEE 515.1.4.1.2–Insulation Resistance Test. Remove and replace cables with measured resistance less than 1000 megaohms to ground.
- C. Perform the following testing after insulation has been installed: Test insulation resistance in cables before energizing per manufacturer's instructions. Testing shall be done with a 2500 VDC megger according to IEEE 515.1.4.1.2–Insulation Resistance Test. Remove and replace cables with measured resistance less than 1000 megaohms to ground.
- D. Verify rated power input. After energizing, test voltage and current simultaneously.
- E. All test reports and megger readings shall be submitted to ENGINEER.

END OF SECTION

SECTION 40 42 13

MECHANICAL INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes insulation for all piping except plumbing and HVAC piping as outlined in Section 23 07 19–Piping Insulation for HVAC, and buried piping insulation as outlined in Section 33 07 19–Buried Piping Insulation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. ASTM C168–Standard Terminology Relating to Thermal Insulation.
 2. ASTM C272–Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 3. ASTM C518–Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 4. ASTM C533–Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 5. ASTM C547–Standard Specification for Mineral Fiber Pipe Insulation.
 6. ASTM C591–Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 7. ASTM C612–Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 8. ASTM C1427–Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 9. ASTM D1000–Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 10. ASTM E84–Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM E96–Standard Test Methods for Water Vapor Transmission of Materials.
 12. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly(Vinyl Chloride) And Poly(Vinyl Chloride-Vinyl Acetate), Rigid.
 13. NFPA 262–Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 150 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.

PART 2—PRODUCTS

2.01 RIGID FORMED FIBERGLASS INSULATION

- A. Acceptable manufacturers are Owens Corning Fiberglas, Johns Manville Micro-Lok, or equal.
- B. Insulation shall be mineral fiber type conforming to ASTM C547, Type IV.
- C. Minimum nominal density shall be of 3.0 lbs/ft³.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service to 850°F.

2.02 FORMED POLYISOCYANURATE INSULATION

- A. Acceptable manufacturers are ITW Insulation System Trymer 2000, Owens Corning Foamular 2000 XP, and Malama Composites AinaCore.
- B. Insulation shall be rigid polyisocyanurate conforming to ASTM C591, Grade 2, Type IV.
- C. Minimum nominal density shall be 2.0 lbs/ft³.
- D. K-factor shall not exceed 0.19 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service range of -290°F to 300°F.

2.03 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive: Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.
- C. Sealant for Metal Jacketing: Acceptable Manufacturers: Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning 727.

2.04 JACKETING

- A. Protective Metal Jackets (PMJ):
 - 1. Acceptable manufacturers are Metal-Clad, or equal.

2. All metal jackets shall include safety edges.
3. Indoor installations: 0.016-inch thick aluminum or 0.010-inch thick 304 stainless steel with safety edge.
4. Outdoor installations: 0.024-inch thick aluminum or 0.016-inch thick 304 stainless steel with safety edge.

2.05 INSULATION INSERTS AND PIPE SHIELDS

- A. Acceptable manufacturers are B-Line, Pipe Shields, or Value Engineered Products.
- B. Construct inserts with calcium silicate or polyisocyanurate with minimum 140 psi compressive strength. Provide 16 gauge galvanized steel shield, 12 inches long. Insert and shield shall include minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. In corrosive (NEMA 4X) or hazardous (Class I, Division 1) environments, shields and distribution plates shall be constructed of 316 stainless steel.
- C. Where CONTRACTOR proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- D. Wood blocks will not be accepted.

2.06 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Where metal jackets are used, band material shall match jacket material. Minimum thickness shall be 0.015 inch for aluminum.
- D. Load distributing metal shields shall be constructed of aluminum. Where metal jackets are used, shield material shall match jacket material. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.
- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- B. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves.
- E. All uninsulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

3.03 RIGID FORMED FIBERGLASS INSULATION INSTALLATION

- A. Provide finished edges at all valves and ends of insulation.
- B. Provide additional insulation trim pieces over flanged joints to completely insulate and seal to the thickness specified.
- C. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions. All insulation ends shall be tapered and sealed regardless of service.

- D. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be molded foam glass insulation.

3.04 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Where practical, slip insulation on piping during pipe installation while pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

3.05 PROTECTIVE JACKET INSTALLATION

- A. Protective Metal Jacket (PMJ): Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands shall be constructed of the same material as the jacket. Locate seams on bottom for exterior applications. Seal laps with 1/8-inch bead of metal jacketing sealant to prevent water entry.
- B. Vapor Barriers:
 - 1. On systems operating at 50°F and above, pipe insulation jackets may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge. Mastics used shall be "breather" type allowing passage of water vapor.
 - 2. On systems operating below 50°F, insulation laps shall be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive. Jackets shall be applied with a continuous unbroken vapor seal. Mastics and adhesives used shall be vapor retarding type limiting passage of water vapor.

3.06 ABOVE GRADE PIPING INSULATION

- A. Provide insulation on new piping as indicated in the schedule below. "Process Piping" shall be defined as piping conveying one of the fluids listed below:
 - 1. Waste and return activated sludge.
 - 2. Air.

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1-1/2" to < 4"	4" to < 8"	8" and Larger
Air (A) less than 7 feet form grade level.	Rigid Formed Fiberglass	PMJ	1.5"	1.5"	2"	2"	2"
Heat Traced Waste Activated Sludge (WAS)	Formed Polyiso.	PMJ	2"	2"	2"	2"	2"

- B. Where schedule indicates multiple layers of insulation, (for example, (2) 1" indicates 2 layers of 1-inch insulation) layers shall be applied with staggered joints.

3.07 HEAT TRACE

- A. Coordinate installation of heat tracing with Division 26. Heat tracing shall be installed prior to installation of insulation. See Section 40 41 00–Heat Trace.

END OF SECTION

SECTION 40 70 00

CONTROLS AND INSTRUMENTATION EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Controls and instrumentation equipment provided with equipment in Division 46.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. UL labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures. Electrical equipment shall include, but not be limited to, control panels, power supplies, controllers, relays, wire, selector switches, pilot lights, overcurrent devices, and connectors. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels which have individual components which are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- B. NEMA/ANSI Compliance: Comply with National Electrical Manufacturer's Association, American National Standards Institute and other standards pertaining to material, construction and testing, where applicable.
- C. Code Compliance: Comply with the National Electrical Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

1.03 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- C. Provide product data on all equipment and devices specified herein, as well as wiring schematics for all systems.
- D. Provide load calculations showing battery runtimes and UPS sizing including all equipment specified herein.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source, and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store in a clean dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to equipment components, enclosure, and finish.

PART 2-PRODUCTS

2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each panel door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. Enclosures shall be as manufactured by Hoffman or Saginaw. Enclosure rating shall be as noted in the associated specification section.
- B. Where necessary for the installed conditions, including direct sunlight or high-temperature environments, control panels shall be provided with louvers and filtered forced-air cooling as required to maintain internal ambient air temperatures 10°F below the rated operating temperature of all internal control panel equipment. Where the installed cooling system does not adequately maintain ambient air temperatures inside the control panel, additional cooling equipment shall be provided by the supplier at no cost to OWNER.
- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations. For outdoor panels, indicating and control devices shall be mounted on a swing-out inner door.
 - 1. All wiring within control panels shall be insulation-type MTW, minimum size 16 AWG. Wiring within the enclosure shall be routed through plastic wiring troughs with removable covers. Maximum fill for wiring troughs shall be 60%. Terminal blocks located adjacent to wiring troughs shall be between terminal block and trough. All wiring in control panels not in wiring troughs shall be bound with continuous-type spiral windings.
 - 2. All I/O devices shall be wired to DIN rail-mounted terminal blocks.
 - 3. Field wiring in dry locations shall be insulation-type THHN, minimum size 14 AWG. Field wiring in damp or wet locations shall be insulation type XHHW-2, minimum size 14 AWG. All field wiring shall terminate on DIN rail-mounted terminal blocks. Field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Wire markers shall be heat-shrink-type. Wire numbering preprinted on the conductor, or insulation, flag-type labels, and individual wraparound numbers are not acceptable.
 - 4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.

5. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
 6. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminal, wired to terminal strips. Spare terminals shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).
- D. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal blocks shall be mounted at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and record drawings.
 - E. All door-mounted devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate worded by the manufacturer and reviewed by OWNER (upon receipt of shop drawings) shall be provided for each component, device, light, etc. All components within the enclosures shall be identified with stick-back adhesive, self laminating, machine printed labels with white background and black text; minimum 12 point font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
 - F. Enclosures that include motor controllers shall have a main disconnect for the enclosure.
 - G. Manufacturer of Accessories:
 1. The plastic wiring duct shall be Panduit Panduct, or equal.
 2. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.
 3. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
 4. Power supplies shall be Sola, DIN rail mount, SPD or SDN Series, or equal.
 5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.

2.02 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. Power supplies shall be protected against short circuits and contain their own overcurrent and overvoltage protection. Twelve and 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- D. All motor control power shall be 120-volt with suitable circuit protection fuses or breakers. Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- E. Devices powered at 120 volts from control panels shall be fused. This shall include, but not be limited to, flow meters, scales, and transducers.
- F. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and

relays, if necessary, to obtain supervisory power. Lightning protection shall be completely solid-state and self-healing and not require the use of fuses. Lightning protection shall be as manufactured by Citel, Model DS240, or equal. Surge protection shall be provided for all phases and neutral.

- G. Each panel shall have a GFI, duplex, 15-ampere, 120-volt receptacle.
- H. Control panels that include programmable or electronic controllers (e.g., PLCs) shall be provided with a 120-volt AC true on-line UPS backup that will provide continuous operation for at least 30 minutes following a power failure.
 - 1. UPS power shall be provided, at a minimum, to the following equipment:
 - a. PLCs and I/O cards.
 - b. Network switches, signal converters, and other communication devices.
 - c. Indicating lights and alarm devices.
 - d. Power supplies for loop-powered equipment.
 - e. Intrinsic safety barriers.
 - 2. The UPS shall be plug connected inside the control panel with a dedicated receptacle and overcurrent protection device. All UPS-powered devices shall be continuously powered through the UPS under normal operating conditions. Provide UPS voltage monitoring relays to automatically bypass the UPS when the UPS output rises 110% above or falls 90% below the nominal supply voltage.
 - 3. Provide a stand or shelf within each control panel for the UPS so that the UPS does not sit on the bottom of the enclosure.
 - 4. Each UPS shall be provided with a dry contact output to the programmable or electronic controller to activate an alarm in the event that the UPS batteries need replacement.
 - 5. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.
- I. Where PLCs are installed in control panels, two copies of all programs and documentation files with associated passwords shall be turned over to OWNER at final completion. Copies shall be USB flash drives.
- J. If enclosure and panel space is needed for future installation of devices, lights, etc., the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.
- K. Control panels that include PLCs shall have an exterior panel-mounted receptacle and programming port mounted to the front of the panel, as applicable to the installation. Receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door. Programming port shall match that of the network being installed (e.g., Ethernet, data highway, etc.).
- L. CONTRACTOR shall furnish one complete extra set of fuses and similar parts which may need replacement in normal service and an identification list of all component parts and where they may be obtained for operating the system for 3 years from start-up.
- M. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.

- N. All internal wiring shall be color-coded and numbered, and each wire shall be terminated on terminal blocks. Schematic and wiring layout drawings complying with Section 26 09 10—Controls and Instrumentation Drawings which show all connections to external devices, a complete bill of materials, interior and exterior panel layouts, and a detailed description of operation, shall be submitted for each control panel.
- O. Each analog signal entering or leaving a control panel and leaving a building shall be provided with a surge protection device as manufactured by Citel, Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel, Model TSP15M on the output and Citel, Model No. DS240 on the power supply, or equal.
- P. The “Hand” mode for all “Hand-Off-Auto” selector switches shall be hard-wired directly to the associated VFD completely bypassing any PLC or controller.
- Q. Daisy chaining neutrals and power wires shall not be allowed.

2.03 CONTROL PANEL DEVICES

- A. All control panel devices shall comply with Section 26 09 00—Controls and Instrumentation.
- B. Variable Frequency Drives (VFDs) and motor control devices shall comply with Section 26 24 19—Motor Control.
- C. Overcurrent protection and disconnecting means for equipment shall be provided as specified in the specification section for the associated equipment. Molded case thermal magnetic circuit breakers shall include integral thermal and instantaneous magnetic trip in each pole. Motor controllers shall include molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Nonfusible switch assemblies shall consist of quick-make, quick-break load interrupter enclosed knife switch with externally operable handle.
- D. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified in the associated equipment specification section. Pushbuttons in hazardous locations shall be rated NEMA 7. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- E. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified in the associated equipment specification section. Indicating lights in hazardous locations shall be rated NEMA 7. Indicating lights in exposed, outdoor locations shall be rated NEMA 4X.
- F. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified in the associated equipment specification section. Selector switches in hazardous locations shall be rated NEMA 7. Selector switches in exposed, outdoor locations shall be rated NEMA 4X.
- G. Timing Relays: UL Listed with On and Timing Out LEDs.
- H. Contactors: All contactors for starters specified herein, including VFDs, shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- I. Elapsed Time Meters: Redington/Engler 722 series, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.

- J. Control Power Transformers: 240/120-volt secondary. Each motor starter shall have a dedicated control power transformer.
- K. Industrial control and power relays shall be installed in control panels where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays.
- L. Relays shall meet the following requirements:
 - 1. Interposing/isolation relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 Vac, or as required by System Supplier.
 - d. Contact rating: 8 A (DPDT), 16 A (SPDT).
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
 - 2. General purpose relays:
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 Vac.
 - d. Contact rating: 15 A, minimum; 3/4 hp.
 - e. Operating life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 - 3. UPS voltage monitoring relays:
 - a. Configuration: SPDT.
 - b. Mounting: DIN rail.
 - c. Voltage: 120 Vac.
 - d. Contact rating: 15 A.
 - e. Operating life: 10 million cycles.
 - f. Over-voltage range: 80 to 150 Vac, adjustable.
 - g. Under-voltage range: 30 to 95% of pickup, adjustable.
 - h. Drop-out time delay: 0.1 to 10 seconds, adjustable.
 - i. UL listed.
 - j. Manufacturer: Macromatic, VWKE120A, or equal.
- M. Operator Interface Panels (OIPs) shall comply with Section 26 09 00—Controls and Instrumentation.

2.04 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
 - 1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
 - 2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
 - 3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.

- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

2.05 MICROLOGIX PROGRAMMABLE LOGIC CONTROLLERS

- A. Construction:
 - 1. A single chassis shall house the CPU, memory, embedded I/O circuitry, communications, power supply and display.
 - 2. The PLC shall be able to operate in an industrial environment with an ambient temperature of (4°F to 140°F).
 - 3. The PLC shall be able to operate in a free airflow environment.
 - 4. The PLC shall be able to operate in high electrical noise environments.
 - 5. The PLC shall support up to 7 front accessible expansion modules for a total of up to 256 discrete I/O: Each input and output point shall have a visual indicator to display ON/OFF status.
 - 6. The CPU shall be a self contained unit, and shall be capable of:
 - a. Providing system timing and scheduling I/O updates.
 - b. Controlling all I/O scanning and communications service.
 - c. Performing internal diagnostic checks and providing visual indication by illuminating a “green” indicator when no fault is detected and a “red” indicator when a fault is detected.
 - d. The CPU shall have a real time clock.
 - 7. Non volatile memory shall store the operating system, user program and all user data to protect against memory loss in the case of power loss or system shutdown. The PLC shall be capable of storing a minimum of 10 KB of data and 10 KB of program.
 - 8. A minimum of four isolated discrete input groups, one isolated analog input group, six isolated discrete output groups and one isolated analog output group shall be located on the self contained controller. At least four relays shall be individually isolated.
 - 9. The manufacturer shall have available a variety of I/O modules including, but not limited to, AC or DC discrete input, AC or DC relay contact output:
 - a. Inputs: 120 VAC, 24 VDC, DC sink, DC source, 4 20 mA analog, and RTD.
 - b. Outputs: 120 VAC relay, 24 VDC relay, 4 20mA analog.
 - c. Discrete I/O modules shall be 120 VAC, unless noted otherwise.
 - 10. Programming Environment:
 - a. The programming port shall be RS 232 or Ethernet/IP.
 - b. The programming software shall run on the latest version of Windows and the programming methods shall be IEC 61131 compliant:
 - (1) Ladder–Project Tree navigation and simultaneous multiple rung editing:
 - (2) Online editing.
 - (3) Data logging.
 - (4) Diagnostics.
 - (5) Reporting.
 - 11. Communication:
 - a. Two dedicated serial ports that support RS 232 and one serial port that supports RS 485; DF1, DH 485, Modbus RTU, DNP3, ASCII. These ports shall be capable of local and remote programming, troubleshooting, and data manipulation.
 - b. One RJ 45 port that supports 10/100 Mbps Ethernet; Ethernet/IP, Modbus TCP, and DNP3 over IP. This port shall be capable of local and remote programming, troubleshooting, and data manipulation.
 - 12. Power:
 - a. The PLC shall operate on 120 VAC or 24 VDC.

- b. The onboard power supply shall be capable of supplying all necessary power to all subsystems (CPU, memory, local I/O, etc.) in addition to a minimum of seven expansion I/O modules, without external wiring.
 - c. The power supply shall provide surge protection, isolation and power outage carryover of at least one cycle of the AC line.
 13. The PLC shall have a simple embedded display with the ability to monitor/change user data, display messages and data to the user, receive numeric input, and provide access to two electronic trim pots which can each be adjusted between 0 and 250 for use in the controller's program.
- B. The PLC shall be as manufactured by Rockwell Automation MicroLogix 1400 Series, or equal.
- C. Manufacturer shall provide all the equipment necessary for data gathering, monitoring, and control as specified herein and shown on the Drawings. Each PLC system shall include, but not be limited to, CPUs with adequate memory and instructions, local power supplies, I/O modules, communications modules, and all other components required to make the PLC perform all required functions. Each PLC shall be mounted in new enclosures where specified herein or shown on the Drawings. The PLC enclosures shall be completely assembled, prewired, and tested at the System Supplier's factory.
- D. PLC Programming and PLC Software: Manufacturer shall provide all PLC programming and software required to meet this specification. The software shall include, but not be limited to, the following:
 1. PLC logic programs to be written by Manufacturer for the PLC systems to accomplish the monitoring and control functions as specified herein. The Manufacturer shall document and annotate the programs, update them as required after startup, and then turn the programs over to OWNER on two USB flash drives.
 2. All I/O addressing that is to be viewed or manipulated by the HMI software shall be organized into contiguous blocks of integer tags for discrete bits and floating point tags for all other values to facilitate block data transfer between computers and PLCs.

2.06 INDUSTRIAL ETHERNET SWITCHES

- A. Provide unmanaged Ethernet switches for networks shown on the Drawings that include only personal computers and/or PLCs. Unmanaged switches shall be as manufactured by Hirschman, Spider Series, Allen-Bradley Stratix 2000 Series or Siemens SCALANCE X-100 Series and include fiber and copper ports to accommodate wiring shown on the Drawings. Each switch shall include the following.
 1. Full/half-duplex operation.
 2. Auto-sensing speed and flow control.
 3. IEEE 802.3 compliance.
 4. DIN rail mounting and a 24-volt DC power supply input. Provide a dedicated power supply, Hirschmann Model RPS Series, or equal.
 5. Store and forward switching.
 6. Minimum of 4 copper ports.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 INSTALLATION

- A. All control panels and equipment enclosures shall be cleaned of debris and wires neatly arranged with surplus length cutoff. Spare wires shall be labeled as "spare" and where the wires terminate.
- B. Where louvers are provided in enclosures or control panels, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in enclosures or control panels, all filters shall be replaced with new at the time of final completion.
- C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.
- D. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment during construction, the equipment shall be refinished by CONTRACTOR. One can of touch-up paint shall be provided for each different color factory finish that is to be the final finished surface of the product.

3.03 WIRE IDENTIFICATION

- A. Conductors shall be grouped as to circuits and arranged in a neat manner. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- B. Power Conductor Insulation Color Code:
 - 1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination.
 - 2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
 - 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
277/480 Volts Four Wire	Grounded Neutral	White
	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

- C. Control Panel Control Conductor Insulation Color Code:
 - 1. All conductors shall have color-coded insulation.
 - 2. Colors:

System	Conductor	Color
Supply Voltage	Ungrounded Circuit Conductors	Black

	Neutral	White
Discrete 120-volt AC Input/Output	Control Circuit Conductor Neutral	Red White
Discrete 12/24-volt DC Input/Output	Control Circuit Conductor Common	Blue White with Blue Stripe
Conductors energized when the main disconnect is in the "off" position (e.g. foreign supply voltages)	Control Circuit Conductor AC Neutral DC Common Ground	Orange White White with Blue Stripe Green
Intrinsically Safe	Control Circuit Conductor DC Common	Light Blue White with Two Light Blue Stripes

- D. Circuit Identification:
1. Identify power, instrumentation, and control conductors at each termination.
 2. Conductors fed from remote panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
 3. Control conductor identification shall match the associated terminal block label.
- E. Data/Voice Cable and Communication Equipment Identification: All communication cables shall be labeled on both ends.
- F. Terminal Block Identification:
1. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
 2. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and amperage rating.
- G. Labeling Font Requirements:
1. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
 2. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

3.04 SYSTEM START-UP AND SUPPORT SERVICES

- A. On-Site Functional Acceptance Testing:
1. After all equipment has been installed and is placed in full-time installed and placed in full-time operation, CONTRACTOR and manufacturer shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
 2. All control wiring, hardwired interlocks, OIP screens, control programming, etc., shall be checked out and functionally tested by manufacturer prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
 3. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, ENGINEER will make one 1-day trip to check operation. CONTRACTOR and manufacturer shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to the control system, as necessary. If the equipment

and controls do not operate according to the Contract Documents, or if CONTRACTOR and manufacturer are not present during the scheduled testing, there will be deducted from payments due to CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses, and for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.

4. Manufacturer shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- B. Final acceptance and payment for panels that include programmable controllers will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. Manufacturer shall include in Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
 2. Satisfactory operation of software.
 3. Satisfactory operation of control program.
 4. Satisfactory operation of peripheral equipment.
 5. The necessary debugging programs have been performed.
 6. Data output is reliable.
 7. Control loops are operational.
 8. Checking and calibrating of systems have been completed.
- C. Manufacturer shall provide the following support services:
1. Field Service Engineer: Field Service Engineer shall be responsible for programming of system PLCs in the factory and at the site. Field Service Engineer shall be present for start-up of all systems and available throughout the entire construction process until final completion. Service technicians sent for system start-up will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
 - a. Commissioning, installation, start-up, and testing of equipment.
 - b. Revising or rewriting manuals to incorporate an installed and accepted system.
 - c. On-site training.
 - d. Software modifications.
 2. In-Factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
 - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
 - b. Program modifications.
 - c. Revising or rewriting manuals.
 3. Post start-up support shall include follow-up services during the 1-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. Enhancement hours and associated trips to the site shall be as specified in the individual specification sections.

3.05 OWNER LOOP/DIGITAL VERIFICATION SIGN-OFF

- A. Adjusting:
1. Set Points: Alarm and control set points shall be adjusted to their operational values before the start of the field test.

2. Calibration: Calibration adjustments shall be performed before the start of the field test. Testing shall commence after calibration verification for each instrument is provided to the Engineer.
- B. Field Quality Control:
1. Piping Tests: After piping systems have been put into service, inspect for leaks. Adjust pipes, valves, or fittings to stop leaks; replace equipment if leak persists.
 2. Field Test:
 - a. A technical representative of the system integrator and the Contractor shall perform a field test on the entire instrumentation and control system. All equipment provided by the system integrator and all interrelated equipment provided by other suppliers, such as pumps, blowers, valve operators, chemical feeders, motor controls, etc., shall be installed and operating properly before the test starts.
 - b. All test equipment and materials shall be provided by the system integrator.
 - c. As a minimum, the test shall consist of the following:
 - (1) All wiring shall be checked at each termination point for correct wire size, type, color, termination, and wire number.
 - (2) All instruments and devices shall be checked to verify compliance with the specifications and approved shop drawings. The calibration of analog devices shall be verified including the zero and span.
 - (3) Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.
 - (4) All digital inputs shall be activated at the field element to verify proper response on the OIT.
 - (5) All analog inputs shall be tested at the field transmitter over a full range to verify proper response at OIT. Analog loops shall be verified at each termination point at 0, 25, 50, 75 and 100% signal levels.
 - (6) All digital and analog outputs shall be forced, via the OIT, or PLC if necessary, to verify proper response at the final control element.
 - (7) Communications shall be tested between all components, including existing equipment.
 - (8) Verify proper calibration of all instruments by independent measurements, such as checking levels with a measuring rod or pole, performing drawdown tests on wells to check flow rates, performing laboratory tests on samples, etc.
 - (9) Create temporary test conditions to simulate variations in process operation by throttling valves, controlling pump speed, shutting down process equipment, operating safety devices, etc. Where safety concerns or process limitations prohibit physical simulation and when agreed to by the Owner, simulated process signals may be used. Test conditions shall be sufficient to test the operation of every function of the instrumentation and control system including:
 - (a) Alarms and safety shutdowns.
 - (b) Equipment start/stop and speed controls.
 - (c) Pacing of chemical feed equipment.
 - (d) Recorders and indicators.
 - (e) Process controller operation and recovery from upsets.
 - (f) Programmable logic controller (PLC) or Supervisory Control and Data Acquisition (SCADA) system inputs and outputs.
 - (g) PLC or SCADA system programming.
 - (10) The test shall be performed according to the test procedures submitted. As each phase of the test is completed, test data sheets shall be signed and dated. The test data sheets shall document any modifications to the control and alarm settings, process engineering unit changes, programming changes,

wiring changes, problems encountered, and steps taken to solve the problems.

- (11) The commissioning effort shall be documented using forms similar to the sample Loop Validation/Inspection Tests form at the end of this Section.

END OF SECTION

**SAMPLE
CALIBRATION CERTIFICATE**

Job Name: _____ Contract No.: _____
 Tag Number/Loop Number: _____
 Loop Description: _____
 Instrument Location: _____
 Manufacturer: _____
 Model Number _____
 Adjustable Range: _____
 Calibrated Range: _____
 Remarks: _____

Installation Per Manufacturer's Requirements? Yes No
 Installation Per Contract Documents? Yes No
 If "No", explain: _____

Calibration Test:

	Input (Units)	Output (Units)	Accuracy
0%	_____	_____	_____
10%	_____	_____	_____
25%	_____	_____	_____
50%	_____	_____	_____
75%	_____	_____	_____
90%	_____	_____	_____
100%	_____	_____	_____

Switch Test:

	Setting	Deadband	Switch Point Upscale	Switch Point Downscale
Setpoint 1	_____	_____	_____	_____
Setpoint 2	_____	_____	_____	_____
Setpoint 3	_____	_____	_____	_____
Setpoint 4	_____	_____	_____	_____

CALIBRATION CERTIFICATE (cont.)

I hereby certify that the above information is correct and accurate, to the best of my knowledge, and that the instrument indicated above has been supplied, installed, calibrated, and tested in accordance with the manufacturer's recommendations and the Contract Documents, unless otherwise noted.

Receipt of this Calibration Certification shall in no way imply acceptance of any work or instrument supplied as a part of this Contract.

CONTRACTOR'S Signature: _____ Date: _____
CONTRACTOR'S Printed Name: _____

System Integrator's

Authorized Manufacturers
Representative Signature: _____ Date: _____

Representative Printed Name: _____
Phone Number: _____

Tester's Signature: _____ Date: _____
Tester's Printed Name: _____
Phone Number: _____

SECTION 41 22 23

DAVIT CRANES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Stationary davit cranes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. CMAA–Crane Manufacturers Association of America.
- B. MHI–Material Handling Institute, Inc.
- C. ANSI–American National Standard Institute.
- D. HMI–Hoist Manufacturers Institute.
- E. MMA–Monorail Manufacturers Association.

1.03 SYSTEM DESCRIPTION

- A. Davit Crane System: Davit crane systems shall include items specified in this section as appropriate and all other specified accessories necessary to provide a complete functioning system.

1.04 PERFORMANCE REQUIREMENTS

- A. Davit Crane System: CONTRACTOR shall conduct start-up and testing of crane systems to demonstrate that load capacity and total system operation meet the requirements and intent of the Contract Documents.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 PORTABLE DAVIT CRANES

- A. Portable davit crane shall be Thern, Inc. Model 5PF5-X-E2X, or equal. Crane shall have a grey epoxy paint finish, with grey epoxy electric winch. Winch shall be Model M4022PB-K by Thern, or equal. Provide Model TK4 socket base cover for each base. Provide one 3/16-inch 304 stainless steel wire rope cable with swivel hook and swaged ball fitting for each crane provided.

B. Portable crane schedule is as follows:

Building	Hoist Capacity	No. of Hoists	No. of Bases	Cable Length
Structure 60	150 lb	1	1	20 ft

2.02 FINISHES

A. Davit cranes shall be factory-finished painted with the manufacturer's epoxy paint finish system.

PART 3-EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Install equipment as indicated and according to supplier's and manufacturer's instructions.
- B. CONTRACTOR shall inspect the units after delivery to the site for any damage to the units during shipping.

3.02 FINISHING

A. CONTRACTOR shall provide finish paint as required by Section 09 91 00-Painting.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. CONTRACTOR shall provide final adjusting, cleaning, and protection in accordance with Division 01. CONTRACTOR shall make all final adjusting on equipment as required by manufacturer. CONTRACTOR shall leave equipment in a clean condition.

3.04 LUBRICATION

A. CONTRACTOR shall furnish a 1-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

END OF SECTION

SECTION 43 11 33

TRI-LOBE POSITIVE DISPLACEMENT BLOWERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation five positive displacement blower packages (B-20-01, B-20-02, B-20-03, B-60-01, and B-70-01). Three blower packages will be for the aeration tanks, one blower package will be for the postaeration tank aeration and mixing, and one blower package will be for sludge storage aeration and mixing. Blowers shall be shaft driven and of the rotary three-lobe type. Each blower package unit shall be provided with integrated pulsation cancellation and sound attenuating enclosures. The blowers, enclosures, and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR shall coordinate with Section 46 51 21–Coarse Bubble Diffusers and Section 46 51 46–Membrane Diffusers.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The Aeration Tank Blowers, B-20-01, B-20-02, B-20-03, shall be installed outside, adjacent to the Aeration Tanks (Structure 20) as shown on the drawings and will be used for mixing and aeration of the Aeration Tanks.
 - 2. The Post Aeration Tank Blower, B-60-01, shall be installed outside, adjacent to the Disinfection and Post Aeration Structure (Structure 60) as shown on the drawings, and used to aerate Final Effluent.
 - 3. The Sludge Storage Blower, B-70-01, shall be installed outside, adjacent to the Sludge Storage Tank (Structure 70) as shown on the drawings, and will be used for mixing and aeration of the Sludge Storage Tank.
 - 4. All blowers shall be capable of running continuously and be capable of intermittent on-off operation. Blower speed shall be adjustable, controlled by variable frequency drive (provided by Division 26).
 - 5. The blowers shall be capable of being started at full speed against a discharge pressure of up to 9.0 psig without use of an unloading valve.
 - 6. Each blower package shall arrive at the job site as a complete assembly ready for installation including the integral steel skid base, V-belt drive and motor, inlet and discharge silencers, pressure relief valve, inlet and outlet flexible connectors, and sound enclosure.
- B. Performance Requirements:
 - 1. Aeration Tank Blowers shall be capable of delivering a design maximum 295 scfm when operating against a pressure of 7.5 psig (measured at the blower outlet). Sludge Storage Tank blower shall be capable of delivering 120 scfm when operating against a pressure 6.0 psig (measured at the blower outlet). Post Aeration Tank Blower shall be capable of delivery 80 scfm when operating against a pressure of 5.5 psi. Each blower shall be capable of meeting these requirements at ±955 feet elevation and 100°F inlet

temperature. Blower manufacturer shall supply performance curves verifying blower speed and output.

2. Maximum blower speed for the blowers at the design capacity specified herein shall be 4,205 rpm for the Aeration Tank Blowers and 3,669 for the Sludge Storage Tank Blower 2,684 rpm for the Post Aeration Tank Blower, 4,205 rpm for the Aeration Tank Blowers and 3,669 for the Sludge Storage Tank Blower. Higher speed shall only be allowed upon approval by OWNER.
3. Noise pressure levels measured 3 feet from the exterior of the sound enclosure shall be less than 70 dBA when the blower is operating at design speed and pressure.

1.03 DEFINITIONS

- A. The following definitions or abbreviations apply to the work and products of this section:
Standard Conditions: Inlet air temperature of 68°F, an inlet pressure of 14.7 psia, and a relative humidity of 0%.

1.04 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization or Substantial Completion of the project.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The Aeration Tank Blower packages shall be model GM10S and the Sludge Storage Tank and Post Aeration Tank Blower Packages shall be model GM4S by Aerzen USA Corporation of Coatesville, Pennsylvania; or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The drawings and specifications were prepared based on Aerzen USA Corporation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by CONSULTANT to accommodate substitutes.

2.02 BLOWER CONSTRUCTION

- A. Casing: The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to resist deflection and facilitate cooling. The casing shall be precision machined to allow for minimum clearances. The casing design shall incorporate channels at the discharge port to minimize pulsation.
- B. Rotor Assemblies: The rotor assemblies shall be precision machined from high strength, close grained, spheroidal graphite ductile iron allowing smooth, efficient operation at all rated speeds and pressures. Rotors shall be solid. The integral shafts shall be designed to carry higher loads than calculated for the maximum design load and shall incorporate replaceable seal ring wear sleeves. The rotor assemblies shall be statically and dynamically balanced. Removal of material from the face of the rotor for balancing purposes is not allowed. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
- C. End Plates:
 - 1. The gear-end plate shall be cast iron. Bearing fits shall be precision machined to provide accurate positioning of the rotors in the casing. Replaceable seal wear inserts shall be provided on the drive end and gear end plates.
 - 2. The end plate covers shall be heavy-duty cast iron with a precision-machined sealing face. Aluminum oil sump covers are not allowed.
- B. Timing Gears:
 - 1. The rotor timing gears shall be precision machined from case hardened and ground alloy steel. Each timing gear shall be straight or helical cut and beveled to provide long life as well as quiet operation.
 - 2. Gears shall be finish ground on a precision grinder to provide concentricity. The timing gear set shall be taper-mounted on the rotors for improved rebuilt ability and accurate timing. Keyed, hub-mounted, or taper-pinned timing gear mounting designs are not acceptable.
- C. Bearings: All four shaft support locations shall incorporate large, heavy-duty cylindrical or spherical roller bearings designed to handle extreme radial loads without sacrificing product integrity and reliability. The minimum acceptable L_{10} design life at the blower's maximum rated speed and maximum rated differential pressure shall be no less than 40,000 hours.
- D. Lubrication: Both the gear-end and the drive-end of the blowers shall be oil splash lubricated for minimal maintenance and long service life. Grease-lubricated bearings are not acceptable. The lubrication design shall provide adequate lubrication of the timing gears and bearings.
- E. Seals:
 - 1. There shall be four piston ring-type labyrinth seals at each end of each rotor to minimize leakage and maintenance costs.
 - 2. The cavity between the air-side and oil-side seals shall be vented through threaded ports to allow external purging or containment of any lubricating oil or process gas that may have migrated past the seals. Enough ports shall be incorporated into the design so that the cavity is vented from the bottom no matter what blower drive-to-driven shaft orientation is utilized.
 - 3. A vent cavity shall be provided on all four sets of piston ring-type labyrinth seals. The two vent holes located on the bottom side of the blower shall be left open. The vent holes at other locations shall be closed off with threaded metal plugs.

4. The input drive shaft seal shall be a high temperature radial lip-type seal with Viton elastomers or sliding ring-type mechanical seal. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.

2.03 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements.
- C. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 1. Physical Construction:
 - a. Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor leads shall have the same insulation class as the windings.
 - b. Rotor bars shall be copper.
 - c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.
 - d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field-regreasable. Openings for addition of grease shall have grease fittings provided.
 2. Mounting: As recommended by the manufacturer.
 3. Enclosure: TEFC.
 4. Efficiency: Premium efficient as noted in schedule below.
 5. Service Factor: 1.15.
 6. Power requirements: 60 Hz, three-phase, 230/460-volt, factory-wired for 460-volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Constant torque.
 8. NEMA Design: B.
 9. Insulation: Class F and rated for a Class B temperature rise (B-20-01, B-20-02, and B-20-03). Class F (B-60-01 and B-70-01)
 10. Nominal operating speed: See motor schedule.
 11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
 12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
 13. Accessories:
 - a. Oversized motor junction box.
 - b. Lifting eyes.
 - c. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 26).
 14. VFD requirements (B-20-01, B-20-02, and B-20-03): Motor operating on VFDs shall be inverter-duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 4:1. Motors shall also include shaft grounding rings as manufactured by AEGIS, or equal.

- D. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Blower	Horsepower	Nominal Speed	Efficiency	VFD
B-20-01	25	1,765	93.6%	Yes
B-20-01	25	1,765	93.6%	Yes
B-20-01	25	1,765	93.6%	Yes
B-60-01	7.5	3,510	90.2%	No
B-70-01	10	3,510	90.2%	No

2.04 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26.
- B. Equipment manufacturer shall review electrical wiring diagrams prepared by the Division 26 CONTRACTOR. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.
- C. Electrical controls and instrumentation for this equipment are specified under Section 26 24 19–Motor Control and Section 26 09 00–Controls and Instrumentation of these specifications.

2.05 VARIABLE SPEED BLOWER CONTROLS (B-20-01, B-20-02, AND B-20-03)

- A. Variable speed drives are specified in Division 26 of these specifications. Care shall be taken in sizing the drive so that adequate starting torque is available for the blowers. This information shall include, but not be limited to, motor full load amps and locked rotor amps and shall be provided to the variable speed supplier specified in Division 26.
- B. Blower controls are specified in Division 26, Section 26 09 00–Controls and Instrumentation of these specifications. Blower manufacturer shall review these controls and coordinate with Division 26.
- C. Equipment manufacturer shall furnish information regarding the minimum motor speed allowed in order to protect the motor and driven equipment to the variable speed drive supplier specified in Division 26. Minimum speed requirements shall be based on actual installed conditions and shall be furnished at or prior to equipment start-up. Calculations showing how minimum speed requirements were determined shall be furnished to ENGINEER for review.

2.06 BLOWER PACKAGES, APPURTENANCES, AND SOUND ENCLOSURES

- A. The packaged blowers are to be standard engineered designs of a CE-certified manufacturer regularly engaged in the production of packaged blowers to provide single source accountability and shall include the following listed standard features:
1. The packages shall be driven through V-belts and sheaves. The drive assembly shall be of the high capacity type, oil and heat resistant, with a minimum service factor of 1.4.
 2. Automatic tensioning of the V-belts by use of a pivoting, swing frame motor base with or without adjustable spring assistance and visual indication of V-belt tension shall be

provided so that the V-belts remain properly tensioned with minimal maintenance and to extend V-belt, sheave, and bearing life. If needed, adjustment of the tensioning device shall be accomplished without removal of the guard or loosening of the motor mounting bolts.

3. The drive guard shall be the manufacturer's standard sheet metal with provision for ventilation. The installed guard shall be fully enclosed, easily removable, and designed to meet current OSHA recommendations and CE standards.
4. The base shall be elevated, rigid, fabricated steel design with a solid subbase. The absorptive type discharge silencer shall be integral to the frame to minimize space requirements. The blower shall be mounted horizontally for a compact frame.
5. To prevent transmission of vibration and noise, as well as secure the package to the foundation, the base shall include vibration isolating mounts. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package so that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the base or the piping.
6. Oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance. The drain valves shall be a ball valve with a fully retained and gasketed threaded cap.
7. The inlet silencer shall be of the absorptive type, directly connected to the inlet port of the blower, and shall be mounted horizontally.
8. The discharge silencer shall be designed specifically for the frequency of the blower for maximum attenuation and shall use a combination of reflection and diffusion. The silencer shall be directly connected to the outlet port of the blower. The discharge silencer shall be mounted horizontally and shall be integral to the base frame.
9. The relief valve shall be spring-loaded and factory-installed in a location to protect the blower from excessive differential pressures. The relief valve exhaust shall be piped out of the enclosure.
10. An unloading start valve shall be provided for blowers B-60-01 and B-70-01, and be factory-installed to allow the motor to accelerate prior to system pressurization and eliminate pneumatic shock.
11. An elastomeric compensator/flex connector shall be provided for connection of the packed blower to the system inlet and discharge piping to reduce transmission of structure borne noise as well as prevent unacceptable loading of the silencer connection and blower casing. On packages with outlets larger than 4 inches, the compensator shall be arch-type, flanged with both ANSI and DIN bolting patterns.
12. A sound enclosure shall be provided. Sound enclosure shall be weatherproof and suitable for external installation. The sound enclosure shall be sheet steel construction with powder coat finish. It shall have acoustic foam insulation and shall provide sound attenuation. The enclosure shall have a hinged or removable panel on top and a removable panel on the front of the package to allow maintenance access. Panels shall incorporate locking closures. At least one installed, integral ventilation fan, sized to provide adequate cooling of the package, shall be provided. The fan shall be powered directly by the blower shaft. 120 V space heaters shall be provided in the acoustical enclosures. Space heaters shall be prewired to thermostat in acoustical enclosure.
13. A blower discharge pressure gauge shall be provided, prepiped and panel-mounted, on the sound enclosure.
14. A blower discharge temperature gauge, with adjustable switching point and contact, shall be provided prepiped and panel-mounted on the sound enclosure (wiring of switch by Division 26) to permit monitoring of outlet air temperature without opening the enclosure.
15. The blower package shall be designed to allow all preventive maintenance to be performed from the front or rear of the package. All utility connections and process connections shall be at the rear of the package.

16. The blower package shall be capable of being installed adjacent to another blower package(s) of similar design and shall be capable of mounting next to the wall without maintenance interference.
17. Provide air check valve installed on the discharge line. Valve shall be as specified in Section 40 05 00.

B. Inlet Filters: Manufacturer shall provide each blower with one inlet filter suitable for outdoor installation. The filter media shall at minimum conform to ASHRAE 52.2 MERV7 50-70% @ 3-10 microns corresponding to EN779 G4. The inlet filter shall be a polyester media inlet filter and shall be sized by the blower manufacturer. Filter element shall be washable by maintenance personnel as a preventive maintenance procedure. A filter differential pressure gauge (maintenance indicator) shall be provided in a location recommended by the blower manufacturer.

C. Factory Testing:

1. All critical dimensions of the blower components actually provided by the manufacturer shall be verified and documented prior to assembly.
2. The rotating parts of each blower actually provided by the manufacturer shall be statically and dynamically balanced before final assembly. The blower alone shall operate without excessive vibration.
3. Each blower actually provided by the manufacturer shall be performance and ISO 1217 to verify flow, Bhp, and slip at design conditions. Test results shall be provided. The slip RPM shall be documented. Each bare blower provided by the manufacturer shall be operated at its maximum rated speed and differential pressure for 30 minutes. A document certifying that the supplied blowers conform to the design specifications shall be provided.
4. On completion of final assembly of the packaged blower and prior to shipment, each packaged blower shall be mechanically run for a minimum of 15 minutes.

2.07 SPARE PARTS

- A. The following spare parts shall be provided for each blower package.
1. One air filter per blower.
 2. Three gallons of lubrication.
 3. One belt set per blower.

2.08 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for applicable atmosphere and high temperature operation. Touchup paint shall be provided by manufacturer.

2.09 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of two trips and two days on site shall be provided for startup and training services.

3.02 VARIABLE SPEED CONTROL COORDINATION

- A. The equipment manufacturer shall coordinate with the variable speed drive supplier at the time of equipment startup to address minimum speed requirements to protect both motor and equipment and to meet specified design and performance requirements. Minimum speed settings (in hertz) shall be provided to OWNER. Equipment operation over the entire control range shall be completed to demonstrate successful operation and to meet specified design and performance requirements.

3.03 FIELD QUALITY CONTROL AND DEMONSTRATION

- A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall conduct a witnessed acceptance test under actual operating conditions to determine the operation is satisfactory and free from excessive vibration as defined by the blower manufacturer. Equipment operation over the entire control range shall be completed.
- B. Should excessive vibration be transmitted to building structure, blower manufacturer shall either provide alternate vibration isolating mounts to correct the vibration or provide alternate blower base inertia blocks with blower base mounted to inertia block and channel frame/forming system around inertia block to mount to spring isolators.

END OF SECTION

SECTION 43 25 10

SUBMERSIBLE PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation submersible pumps and appurtenances. The pumps and appurtenances shall be furnished by the same supplier. They are to include two return activated sludge pumps (RASP-50-01 and RASP-50-02), and two plant drain pumps (P-80-01 and P-80-02).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application:
 - 1. Pumps RASP-50-01 and RASP-50-02 shall be used for pumping return activated sludge from the RAS wet wells to the sludge holding tank and the influent splitter. The return activated sludge is expected to have a solids concentration of 0.5% to 2%.
 - 2. Pumps P-80-01 and P-80-02 shall be used to pump scum, decant from the sludge holding tank, and drain water. These pumps will be able to discharge into the Influent Screen, Aeration Tank, and Sludge Holding Tank.
- B. Design Requirements:
 - 1. The submersible pumps shall meet the following operating conditions:

OPERATING CONDITIONS							
		Head Conditions at Given Flows					
		Normal		Minimum		Maximum	
Pump	Location	GPM	TDH (ft)	GPM	TDH (ft)	GPM	TDH (ft)
RASP-50-01 and RASP-50-02	STR 50 Wet Well	125	6.3	350	8	50	21
P-80-01 and P-80-02	STR 80	200	25	260	14	60	48

- 2. The submersible pump motors shall meet the following operating conditions:

Pump	HP	Voltage	Phase	RPM	Minimum Pump Eff.*	Minimum Motor Eff.*
RASP-50-01 and RASP-50-02	3	460	3	1800	47%	71.3%
P-80-01 and P-80-02	3	460	3	1800	49.17%	71.3%

*Minimum efficiency at normal operating conditions.

- C. Performance Requirements: CONTRACTOR shall supply pumps to meet the following requirements using constant speed operation:
1. Operate at the normal condition within +10% of given capacity at given head, or within +5% of given head at given capacity.
 2. While operating under suction head at the normal operating conditions, the pump design shall be such that the pump will operate satisfactorily without cavitation, excessive noise, or vibration when installed as shown on the drawings and operating at the head specified.
 3. Motor horsepower shown is the minimum requirement. The motor shall be large enough not to be overloaded at any point on the design curve for the pump chosen to meet the operating conditions. In addition, the motor shall be large enough to be non-overloading along the curve from 60% to 140% of Best Efficiency Point (BEP).
 4. The maximum and minimum head conditions are given as a guide to the shape of the head discharge curve. The pumps shall have a head discharge curve of the same shape or steeper within the guidelines previously specified.
 5. Be designed to operate in submerged condition in the space allotted.
 6. Be vertical, nonclog centrifugal wastewater pumps with integral motors designed and assembled by same manufacturer.
 7. Be capable of handling solids and long stringy materials found in raw unscreened wastewater.
 8. With its appurtenances and cable, be capable of operation with continuous submergence without loss of watertight integrity to a depth of 65 feet.
 9. Be capable of running continuously at full nameplate rated load while the pump is submerged, partially submerged or unsubmerged. The use of shower systems, secondary pumps, or cooling systems to cool the motor shall not be acceptable.
 10. Be UL, CSA, or FM approved for Class I, Division 1, Groups C and D hazardous locations.

1.03 QUALITY ASSURANCE

- A. Pumping station shall be in conformance with requirements of all applicable industry codes and laws.
- B. Materials of construction for the pumps and related equipment shall be suitable for the environment in which they are to be located.

1.04 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied to OWNER against defects in workmanship and materials for a period of 5 years or 10,000 hours under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.
- B. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps. Should the impeller clog, manufacturer shall provide unclogging services at no cost to the owner.

PART 2-PRODUCTS

2.01 MANUFACTURER

- A. Submersible pumps shall be manufactured by Ebara, or equal, meeting the following requirements:

Pump	Series	Model	Impeller	Diameter
RASP-50-01 and RASP-50-02	DLMKFU	100DLMKFU62.22	5.71-IN	4-IN
P-80-01 and P-80-02	DLMKFU	80DLMKFU62.2	7.40-IN	3-IN

- B. The Drawings and Specifications were prepared based on Ebara. CONTRACTOR shall include in the Bid, and shall be responsible for, the cost of any changes to accommodate other equipment, including, but not limited to, structural, mechanical, and electrical Work. CONTRACTOR shall also pay any additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 PUMP RETRIEVAL SYSTEM

- A. The design of the pumps shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fasteners to be disconnected, or need for personnel to enter the wet well.
- B. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the wet well and discharge line, will receive the wet well discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices.
- C. Alignment of the pump to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by no less than two stainless steel guide bars. Guide bars shall be of a diameter and wall thickness as recommended by the pump manufacturer. Provide stainless steel top guide bar brackets and intermediate guide bar brackets as required. Guide bars shall extend from access door to the discharge connection. No other motion of the pump unit, such as tilting or rotating, shall be required. Sealing of the pump to the discharge flange connection shall be by a machined metal-to-metal contact. As an alternative, provide a machined groove to hold a molded urethane sealing ring in place to provide a redundant leak-proof seal. No portion of the pump unit shall bear directly on the floor of the wet well. The entire weight of the pump shall be borne by the pump discharge elbow. There shall be no more than one 90° bend allowed between the volute discharge flange and station piping. Discharge connection to discharge pipe shall be an ANSI B16.1 Class 125 flange.
- D. Pumps shall be fitted with a stainless steel cable of adequate strength to permit raising and lowering of the pumps for inspection or removal. Hoist end of pump retrieval cable shall be fitted with a swaged ball to allow for connection to pump lifting equipment. All components shall be of adequate size, length, and strength for the pump being lifted and shall be provided so to allow cable to automatically be wound on cable drum.

2.03 PUMP CONSTRUCTION

- A. All major parts such as the stator casing, lubricant casing, sliding bracket, discharge connection, volute and impeller shall be of gray iron with smooth surfaces. All exposed bolts, screws and nuts shall be stainless steel construction. All metal surfaces coming in contact with the pumped liquid other than steel or brass shall be protected by a manufacturer-selected paint system.
- B. All mating surfaces of major parts shall be machined and fitted with O-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces without the requirement of specific torque limits to affect this. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate or equal. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to provide sealing as described above. No secondary sealing compounds, greases, or other devices shall be used.

2.04 PUMP MOTOR

- A. The pump motor shall be housed in an air-filled watertight chamber and shall have moisture-resistant Class H insulation. The pump motor shall be NEMA Design B designed for continuous duty. Motor shall be capable of sustaining at least 15 evenly spaced starts per hour.
- B. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of $\pm 10\%$. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C . Motor shall be inverter duty rated and meet the requirements of NEMA MG-1 part 31 and be suitable for VFD operation (RASP-50-01 and RASP-50-02).
- C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
- D. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

2.05 PUMP PROTECTION

- A. The motor stator shall incorporate three thermal switches in series to monitor the temperature of each phase winding. At a temperature preset to protect the motor the thermal switches shall stop the motor and be capable of activating an alarm.
- B. A float-type leakage sensor (FLS) shall be provided to detect fluid in the stator. When activated, the sensor shall be capable of stopping the motor and activating an alarm or indicator. The thermal switches and sensor shall be connected to a monitoring unit which shall be designed to be mounted in control panel.
- C. A EMPR4A unit rated for 120 Vac power supply shall be provided for installation in the MCC bucket by the Section 26 09 00 System Supplier.

2.06 PUMP MECHANICAL SEALS

- A. Double mechanical seals operating in an oil bath shall be provided on all units. The oil filled seal chamber shall be designed to prevent over-filling and include an anti-vortexing vane to insure proper lubrication of both seal faces. Lower face materials shall be silicon carbide, upper faces carbon vs. ceramic, NBR elastomers, and 304SS hardware. Seal system shall not rely on pumping medium for lubrication.
- B. The pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive antileak seal shall be easily accessible from the outside. No seal damage shall result from operating the pump in an unsubmerged condition. The seal system shall not rely on the pumped media for lubrication.

2.07 PUMP IMPELLER

- A. The impeller shall be radial single or multi-vane, semi-open design. It shall be dynamically balanced and shall be designed for solids handling with a long thrulet without acute turns. The inlet edge of the impeller vanes shall be angled toward the impeller periphery. The impeller design shall also include back pump out vanes to reduce the pressure and entry of foreign materials into the mechanical seal area. A lip seal shall be located behind the impeller hub to further reduce the entry of foreign materials into the seal area. Impellers shall be direct connected to the motor shaft with a slip fit, key driven, and secured with an impeller bolt. The design shall include a replaceable cast iron suction cover. The suction cover shall contain grooves perpendicular to the suction opening to disrupt fibrous solids that may otherwise become lodged between the impeller and suction cover. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt, and treated with a corrosion inhibitor.

2.08 PUMP MOTOR CABLES

- A. The pump motor cables shall be suitable for submersible pump applications. This shall be indicated by a code or legend permanently printed on the cable. Cable size shall conform to NEC and ICEA Standards and shall be of adequate size to allow motor voltage conversion without replacing the cable. Provide a stainless steel Kellum grip strain relief on motor cable to support cable at manhole cover. Provide cable length as required for continuous run from in-place pump to point of cable connection. All ends of pump cables shall be fitted with a rubber shrink-fit boot to protect cable prior to installation.

2.09 CABLE ENTRY SEAL

- A. A cable entry seal shall be provided where the pump cable enters the pump. The cable entry seal design shall preclude specific torque requirements to provide a watertight and submersible seal. The cable entry shall consist of cylindrical elastomeric grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain-relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by stator lead sealing gland or a terminal board which shall isolate

the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be required or used.

2.10 COOLING SYSTEM

- A. Pump shall be provided with cooling system of thermal radiators integral to the stator housing, cast in one unit. Pump shall be capable of operating in a dry condition without damage to motor or pump.

2.11 VARIABLE SPEED CONTROLS

- A. Variable speed drives are specified in Division 26 of these specifications. Care shall be taken in sizing the drive so that adequate starting torque is available for the RAS pumps. This information shall include, but not limited to, motor full load amps and locked rotor amps and shall be provided to the variable speed supplier specified in Division 26.
- B. RASP-50-01 and RASP-50-02 controls are specified in Division 26, Section 26 09 00– Controls and Instrumentation of these specifications. RASP-50-01 and RASP-50-02 Manufacturer shall review these controls and coordinate with Division 26.
- C. Equipment manufacturer shall furnish information regarding the minimum motor speed allowed in order to protect the motor and driven equipment to the variable speed drive supplier specified in Division 26. Minimum speed requirements shall be based on actual installed conditions and shall be furnished at or prior to equipment start-up. Calculations showing how minimum speed requirements were determined shall be furnished to ENGINEER for review..

2.12 ACCESS DOORS AND ACCESSORIES

- A. Provide aluminum double-leaf access doors as manufactured by Bilco, Nystrom, or equal, for the openings indicated on the drawings. Doors shall be angle-frame design. The doors shall include a positive hold-open arm with release handle and a tubular stainless steel compression-spring operator. Provide doors with flush slam-lock with inside handle and removable key wrench. Aluminum doors shall be mill finish. All aluminum surfaces in contact with concrete shall be painted with bitumastic coating as prescribed by manufacturer. Door hardware shall be zinc plated and stainless steel throughout.
- B. Access cover shall be provided with fall-through protection consisting of aluminum grating designed to withstand live load of 300 pounds per square foot. Grating shall allow for visual inspection, limited maintenance, and float adjustment while the grate is in place. Grate shall be provided with a permanent hinging system which will lock grate in 90 degree position once opened. A locking device to prevent unauthorized entry to the confined space below shall be provided. Aluminum grating shall be powder-coated safety orange.
- C. Doors shall be cast into top slab. CONTRACTOR shall coordinate location of door to provide proper clearance between door and pumps and to allow for proper placement of pumps.
- D. Doors shall be reinforced for minimum HS-20 loading loading.
- E. Provide stainless steel or fiberglass unistruts, as necessary, attached to doors to mount accessories. Accessories (upper guide holder, cable holder, power and float cable holder, etc.) shall be stainless steel.

2.13 PUMP HOIST

- A. Provide one portable stainless steel pump hoist for pump removal. Pump hoist shall be Thern, Inc. portable davit crane, or equal. Hoist shall have minimum 1,000-pound capacity. Provide stainless steel spur gear hand winch. Base for hoist shall be stainless steel socket base (flush mount).

2.14 FINISHES

- A. It is the intent of these specifications that the submersible pumps be furnished shop-primed and factory-finished painted. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for the uses described in these specifications. Touch-up paint shall be provided by manufacturer.

2.15 ANCHOR BOLTS

- A. CONTRACTOR shall provide anchor bolts necessary for equipment furnished. Anchor bolts shall be stainless steel and be of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Refer to requirements specified in Division 01 for field installation, testing, quality assurance, and start-up.
- B. Install in accordance with manufacturer's directions as supplemented herein.
- C. CONTRACTOR shall coordinate the proper location of wet well cover casting in the wet well top slab, placement of the hoist socket, and all associated pump accessories to facilitate installation and removal of pumps. Locations shall be suitable to meet current design and future design conditions without interference.

3.02 PUMP TESTING

- A. Factory Test: Each pumping unit to be furnished shall be fully performance tested with water in the manufacturer's facility in accordance with the Standards of the Hydraulic Institute to determine compliance with the rated conditions. The pump tests shall be witnessed by OWNER at OWNER's option. Notify OWNER at least three weeks in advance regarding the proposed test dates and location. Certified test curves, test data, and computations shall be submitted for approval prior to shipment and shall include the following:
 - 1. Pump performance curves for each of the speeds needed to meet the specified operating conditions defined under Section 1.02(B). Each pump performance curve shall include at least 4 operating points and shall show:
 - a. Head versus Discharge.
 - b. Pump Efficiency.
 - c. Break Horsepower.
- B. Installed Test: Prior to startup at OWNER's facility, manufacturer's representative shall certify that equipment has been properly aligned and installed. During equipment startup,

manufacturer's representative shall confirm each pump is operating properly as specified. Report shall be submitted verifying test. Pump shall be modified if specified conditions are not met.

- C. Start-Up Tests: The pump manufacturer shall perform the following inspections and tests on each pump at start-up:
1. Impeller, motor rating, and electrical connections shall first be checked for compliance to the specifications.
 2. A motor and cable insulation test for moisture content or insulation defects.
 3. Verify correct rotation.
 4. Verify proper voltage.
 5. Verify proper current draw on each phase.
 6. Verify thermal sensor trip will shut down motor in Hand and Auto mode.
 7. A written certified test report giving the above information shall be supplied after start-up.

END OF SECTION

SECTION 46 09 00

SAMPLERS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation two self-contained automatic refrigerated samplers (SA-10-01, SA-60-01) as shown on the drawings and specified herein. Samplers shall be capable of collecting and compositing uniform liquid samples. Sampler shall include suction strainer, sampler jars, tubing, pumps, and other appurtenances for a fully functioning system. All equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Sampler SA-10-01 will collect samples of influent and will be located outdoors, adjacent to the influent screen channel (structure 10) as shown on the drawings. Sampler SA-60-01 will collect samples of effluent and will be located outdoors, adjacent to the UV disinfection structure (structure 60) as shown on the drawings.

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Stationary refrigeration model samplers shall be Model 5800 Refrigerated Sampler as manufactured by Teledyne ISCO, Inc. of Lincoln, NE, Hach Model AS950 as manufactured by the Hach Company of Loveland, CO, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The drawings and specifications were prepared based on ISCO. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply

with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 GENERAL

- A. Products Description: The Refrigerated Samplers shall have controls to offer constant time-constant volume, constant time-variable volume, and variable time-constant volume sample modes and composite or sequential sampling. The samplers shall have 4-20 mA and DC pulse flow meter input. Samplers shall be equipped with slide out bottle rack. The controller shall actively regulate and display the sample compartment temperature and log a 24-hour summary to confirm proper sample cooling.
- B. Materials: Sampler shall be provided with a linear low density polyethylene (LLDPE) cabinet with a UV resistant gel coat for outdoor installation.
- C. Manufactured Units:
1. Sampler shall be of the peristaltic pump type and shall be designed for a maximum suction lift of 28 feet. A line transport velocity of 2 feet/second shall be maintained at 25 feet of head. A positive pressure blow down shall be applied before sample cycle begins. Each sampler shall be provided with 99 feet of 3/8-inch I.D. flexible polyethylene suction tubing. Sampler shall be provided with one 2.5 gallon LDPE sample jug, and one spare 2.5 gallon sample jug, polypropylene sampler chamber and float checks, peristaltic pump and replaceable plug-in timer and control with sampling range from 0 to 60 minutes. The pump shall include a heater housed beneath the pump cover for prevention of liquid freezing inside the pump.
 2. Sampler shall be both constant and proportional type. Sampler shall be self-contained in a refrigerator with thermostatic control. Sampler shall maintain wastewater samples at 4°C. All electrical components shall be designed for operation on 120 V, 60 Hz, single-phase electric service. All controls shall be mounted on the top of the unit. Sampler controls shall be of electro-mechanical design and shall have a power cord with modular plug. Controls shall provide manual timed interval (0-60 minutes) or flow proportional operation of sampler accepting a dry contact closure.
 3. CONTRACTOR shall be responsible for the complete installation of the sampler. Suction tubing to point of sample collection shall be encased in 4-inch PVC pipe, unless otherwise shown on the drawings.
 4. Refrigerator unit shall include CFC free coolant HFC-134a, or equal. Compressor mounting frame shall be stainless steel. Condenser, refrigeration lines, and evaporator shall be powder coated with heat-treated polyester and painted with a rust converter paint overcoat. Unit shall include polyurethane insulation with a thermal resistance factor of R-16.
 5. Provide a stainless steel weighted strainer for sample suction line.
 6. The sampler shall use a nonwetted, nonconductive detector to sense the presence of the liquid at the inlet to the pump. The sensor shall not be dependent on or affected by any compositional, chemical, or physical property of the liquid, including high or low conductivity of the sample. The liquid detector shall require no routine maintenance or cleaning to allow the detector or sampler to operate. The liquid detector shall eliminate entering the head height in programming and shall minimize the effects of changing head or intermittent flow in the suction line on sample volume. Once the liquid has been detected at the pump inlet, the sampler shall deliver repeatable and accurate sample

volumes by counting the revolutions of the peristaltic pump. The sampler shall deliver repeatable sample volumes typically within 10 ml to prevent any single sample from biasing the collected sample.

2.03 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.04 FINISHES

- A. Sampler shall arrive finish painted with manufacturer's standard finish for service intended.

2.05 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and one day on site shall be provided for startup and training services for the samplers.

END OF SECTION

SECTION 46 21 13

MECHANICAL FINE SCREEN

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one new mechanically cleaned screen (MFS-10-01) to be located outside near the Aeration Tanks. Provide all labor, equipment, and material for a complete functioning system including start-up and testing of all equipment and accessories. All equipment and accessories shall be furnished by the same supplier.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. Section 26 09 10–Controls and Instrumentation Drawings.
 - 3. Section 40 70 00–Controls and Instrumentation Equipment.

1.02 SYSTEM DESCRIPTION

- A. Application: MFS-10-01 is to be installed outdoors. The screen shall be used to remove debris, detritus, grit, and other material found in raw sewage influent flow including, but not limited to, tires, wood, and other larger items found in large sanitary sewers.
- B. The bar screen shall be designed for the following:
 - 1. Average daily design flow: 0.180 mgd.
 - 2. Peak design flow: 1.08 mgd.
 - 3. Channel width: 18 inches.
 - 4. Hopper discharge height above channel wall: 5.0 feet.
 - 5. Maximum upstream water level: Approximately 1.14 feet above channel bottom with 1.08 mgd passing through screen and 50% screen binding.
 - 6. Size of clear opening between bars: 6 mm.
 - 7. Angle of screen: Approximately 75 degrees from horizontal.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- C. The following submittal information and data shall be included as part of the shop drawing submittal:
 - 1. Manufacturer's specifications.
 - 2. Detailed catalog information, descriptive literature, and specifications of hardware. All items being provided must be specifically noted on this literature, including all field devices, instruments, principal parts, and materials.

3. Detailed equipment dimensioned drawings.
 4. Installation, assembly, disassembly, and repair instruction including dimensional drawings show all clearances required for maintenance.
 5. Motor nameplate data.
 6. Any exception to these specifications including explanation for nonconformance.
 7. Project-specific wiring diagrams for all control panels. Drawings shall be completed using electronic CAD software. Manufacturer's general, non-project-specific wiring diagrams or handwritten or PDF markups of any kind will not be allowed.
- D. The initial submittal information shall be resubmitted with any required corrections, certifications, and additional details during formal shop drawing review.
- E. Provide detailed performance test procedure following requirements specified herein.
- F. Shop drawings shall include plan drawing(s) showing each heat-trace circuit. Include a bill of material identifying all components and material for each circuit.
- G. Provide product data on heating cables, end terminations, power connections, thermostats, and all accessories.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.
- B. Manufacturer shall warrant the factory installed ceramic lower bearings to be free from defects in material and workmanship for a period of 3 years from the date of start-up. The manufacturer shall replace or repair any part or parts which upon examination shall show to have failed under normal use and service within the warranty period. Warranty shall be provided with the shop drawings.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Screens shall be Kusters Water of Spartanburg, SC, Huber of Denver, NC, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

- B. The drawings and specifications were prepared based on Kusters. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including, but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.
- D. Screen manufacturer shall submit hydraulic headloss calculations at the design flows and mass load calculations for screenings to be transported by the screen.

2.02 MATERIALS

- A. Screen:
 - 1. All structural parts and filter shafting: Type 304 stainless steel.
 - 2. Drive shaft, links and guide rails: Type 304 stainless steel.
 - 3. Sprocket: Type 304 stainless steel.
 - 4. Fasteners: Type 304 stainless steel. All threaded fasteners shall be coated with a nickel based antiseize thread lubricant prior to assembly.
 - 5. Discharge chute: Type 304 stainless steel.
 - 6. Front Cover: Type 304 stainless steel.
 - 7. Discharge Chute Cover: Type 304 stainless steel.

2.03 EQUIPMENT

- A. Screen to be mechanically cleaned; incline of bar screen shall be 75 degrees from horizontal.
- B. Rakes shall approach channel invert from upstream side of screen and rake upward at upstream face with tines between the bars.
- C. Screenings shall be discharged on downstream side of screen into a residential sized tote provided by OWNER.
- D. Framework of screen shall be constructed of Type 304 stainless steel and cross section with a minimum thickness of 3/16 inch. Various parts fastened by welding, riveting, or bolting shall be braced as necessary to provide a rigid structure. The side frames shall be 3/16 inches formed to a channel profile. The bottom thickness shall be 5/16 inches. The frame shall have support beams with U-profile thickness of 3/16 inches on the front above the maximum water line. No braces, gussets, or stiffeners shall be inside the screen frame that will allow for screenings to collect.
- E. The screen frame shall be supplied in one piece requiring no field assembly.
- F. The drive mechanism for the rakes shall incorporate a solid shaft constructed of stainless steel Type 304.

- G. Bolts and nuts shall be of Type 304 stainless steel or other acceptable corrosion-resistant material.
- H. Screen bars shall be constructed of Type 304 stainless steel. The bar rack shall consist of continuous taper section bars.
 - 1. The dimensions of the bars shall be: 6 mm by 3 mm by 40 mm.
 - 2. The screen bars shall be individually replaceable without any welding or cutting. Screen bars that are welded to the framework or welded into subassemblies shall not be allowed.
- I. Replacement screen bars shall be available from the screen manufacturer. Round bars shall not be used.
- J. Bars shall be fastened to a dead plate that extends to the point of discharge.
- K. The screen shall be designed to be pulled out of the channel. Plastic side flaps shall seal the screen to the channel walls.
- L. The screen field shall be accurately constructed to give a clear opening of 6 mm between the bars. There shall be no space wider than the opening between the bars which would permit passage of larger solids through the screen.
- M. Bars shall be supported from framework and be readily removable.
- N. The lower portion of the bar rack shall be curved to optimize the bar rack flow area. The curve of the bars shall match the path of screen rakes such that the rakes positively remove all captured screenings. A curved lower plate in lieu of curved bars shall not be accepted.
- O. Dead plate of Type 304 stainless steel plate (thickness 3/16 inches) shall extend to the point of discharge. Dead plate shall be true and flat such that a close clearance between the raking tines and the plate can be maintained during the cleaning cycle. The back side of the dead plate shall be constructed to guarantee a maximum gap between rake bar and dead plate, leading to the discharge chute without interruption.
- P. The screen rakes shall be designed such that screenings will not wrap around the tines or the stationary bars, and will not fall back into the sewage flow during the cleaning cycle. Screenings transported to the top of the screen shall be discharged positively by means of a scraper mechanism to the discharge chute. A scraper blade made of a combination of synthetic and other material shall be provided on the scraper.
- Q. The raking tines shall have the tooth profile precision cut from a single continuous bar of sufficient thickness and depth to insure adequate stiffness and strength to cope with the specified duty cycle. The rakes shall run in guides on both sides to provide engagement and clean the bars from the upstream side of the screen. The rakes shall be fabricated from stainless steel Type 304. The rake material, thickness of material, and capacity of rake shall be similar to the entire construction:
 - 1. Thickness of rake bar: 3/8 inch.
 - 2. Reinforcement profile: 1/4 inch.
 - 3. Side sheets: 3/8 inch.
 - 4. Screening Capacity:
 - a. Capacity/Rake Bar: 0.056 ft³/ft SFW (Screen Field Width).

- b. Total Screen Capacity (ft³/h): 13 ft³/hour at approximately 10-second cleaning interval.
 - c. Total Screen Capacity (ft³/h): 26 ft³/hour at approximately 5-second cleaning interval.
5. The rake tines shall penetrate into the screen bar spacing so that screenings are completely cleared during each lifting operation. Rake tines shall be mechanically engaged into the screen bars. During each cleaning stroke, the raking tines shall engage into the bottom of the bar screen grids at the channel invert. Drive chains, chain guides, chain sprockets, bearings, and axles shall be fully replaceable without having to remove the screen from the channel.
- R. Lower Chain Guides
- 1. The screen shall be provided with lower revolving sprockets/guides with 8 teeth and a nominal pitch diameter of 13". The sprockets shall have a minimum plate thickness of 1".
 - 2. The lower revolving sprocket/guide bearings shall consist of a life sealed bushing system. The system shall consist of a stainless steel stub shaft supporting a ceramic sleeve. The ceramic collar shall interface with a high lubricity, low friction composite bushing surface to provide zero metal to metal contact. This composite bushing shall be designed for extreme wear life in highly abrasive, high impact environments. Lower bushings that require any maintenance or have metal to metal wear must not be accepted.
- S. The discharge chute and top of screen shall be fully closed. The top of the frame shall be covered with Type 304 stainless steel bolted to the front and back of the frame. The sides of the top cover shall be bent to overlap the side frames. The discharge chute shall be enclosed from the top of the frame to the end of the chute. The chute and chute enclosure shall be manufactured from a single piece of 3/16 inches thick Type 304 stainless steel material.

2.04 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
- 1. Physical Construction:
 - a. Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor leads shall have the same insulation class as the windings.
 - b. Rotor bars shall be aluminum.
 - c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.
 - d. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 - 2. Mounting: Horizontal.
 - 3. Enclosure: TEFC, rated for installation in a Class I, Division 2, Groups C and D location.
 - 4. Efficiency: Premium efficiency as noted in schedule below.
 - 5. Service Factor: 1.15.

6. Power requirements: 60 Hz, three-phase, 230/460-volt, factory-wired for 460-volt connection, $\pm 10\%$ voltage variation.
 7. Load type: Constant torque.
 8. NEMA Design: B.
 9. Insulation: Class F and rated for a Class B temperature rise.
 10. Nominal operating speed: See motor schedule.
 11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
 12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
 13. Accessories:
 - a. Oversized motor junction box.
 - b. Lifting eyes.
 - c. Thermostats applied to motor windings, capable of shutdown and manual reset by external controls.
 14. VFD requirements: Motors shall be inverter-duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown of 10:1.
- C. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Equipment	Horsepower (hp)	Nominal Speed (rpm)	Minimum Nominal Efficiency
MFS-10-01	1	1,755	85.5%

2.05 CONTROLS AND INSTRUMENTATION

- A. General Requirements:
1. All setpoints, alarms, timers, and status monitoring signals shall be available at the plant Supervisory Control and Data Acquisition (SCADA) System. The manufacturer shall be responsible for all coordination with the Section 26 09 00—Controls and Instrumentation System Supplier so that all signals specified herein are provided and are compatible with the plant SCADA System. Refer to the input/output (I/O) listing in Section 26 09 90—SCADA System and I/O Listing for the minimum required I/O between the screening control system and plant SCADA System.
 2. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Section 40 70 00—Controls and Instrumentation Equipment.
 3. The manufacturer shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 20 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that these 20 hours shall include 1 separate trip to the site.

B. Process Control Panel:

1. The manufacturer shall provide a programmable logic controller (PLC)-based screening control system. All communication of system alarms and status signals between the process control panel and the plant SCADA System shall be via Ethernet/IP, unless otherwise noted.
2. Provide a NEMA 12, painted steel, wall-mounted enclosure including, but not be limited to, the following:
 - a. 20-amp main circuit breaker disconnect with door-interlocked, pad-lockable handle. Power to the process control panel shall be 480-volts, three-phase.
 - b. Power distribution and overcurrent protective devices for all internal components powered from this control panel.
 - c. 120-volt, 20-amp circuit breaker for power to LIT-10-01.
 - d. 120-volt, 15-amp GFPE circuit breaker for power to heat trace equipment.
 - e. Variable frequency drive (VFD) and overcurrent protective device for the following equipment: Mechanical fine screen (MFS-10-01).
 - f. Control power transformer.
 - g. PLC, power supplies, communication modules, and I/O modules.
 - h. Relays, terminal blocks, and control devices as required for the process control system.
 - i. Unmanaged network switch with copper quantities as shown on the Drawings. Provide surge protection devices for network cabling routed outside of the control panel.
 - j. True-online uninterruptible power supply (UPS).
 - k. Mechanical cooling sized as required to maintain internal ambient temperatures 10°F below the rated operating temperatures of all internal control panel equipment. Enclosure rating shall match the process control panel enclosure rating.
 - l. Intrinsic Safety Barriers for the high level float switch, and over torque switch.
 - m. Front panel-mounted programming port with RJ-45 jack and 120-volt receptacle.
3. The following devices shall be mounted on the front door of the enclosure:
 - a. Power Off-On selector switch.
 - b. White "Power On" indicating light.
 - c. Green "Screen Forward" indicating light.
 - d. Green "Screen Fast" indicating light.
 - e. Amber "Screen Reverse" indicating light.
 - f. Amber "Screen In Hand" indicating light.
 - g. Red "VFD Fault" indicating light.
 - h. Red "Motor Overtemperature" indicating light.
 - i. Red "Screen Jam Alarm" indicating light.
 - j. Red "High High Level" indicating light.
 - k. Reset pushbutton. (VFD Fault, Motor Overtemperature, and Overtorque).
 - l. Maintained-type, mushroom-head emergency stop pushbutton.
 - m. VFD human interface module.
 - n. Elapsed time meter.

C. Hardwired Motor Controls:

1. Mechanical Fine Screen (MFS-10-01):
 - a. L-O-R Selector Switch (CS-10-01 at the unit):
 - (1) With the L-O-R selector switch in the "Local" position, the motor shall be controlled from the F-O-R selector switch at the unit.
 - (2) With the L-O-R selector switch in the "Off" position, the motor shall be inoperable

- (3) With the L-O-R selector switch in the “Remote” position, the motor shall be controlled from the PLC in this control panel.
- b. F-O-R Selector Switch (CS-10-01 at the unit):
 - (1) With the F-O-R selector switch in the “Forward” position, the motor shall operate in the forward direction and shall run at the speed selected from the S-F Selector Switch noted below.
 - (2) With the F-O-R selector switch in the “Off” position, the motor shall be inoperable.
 - (3) With the F-O-R selector switch in the “Reverse” position, the motor shall operate in the reverse direction and shall run at the preset low speed setpoint. The “Reverse” position shall spring return to the “Off” position.
- c. S-F Selector Switch (CS-10-01 at the unit):
 - (1) With the S-F selector switch in the “Fast” position, the motor shall operate in the forward direction and shall run at the preset high speed set on the VFD HIM when called to run from the PLC or F-O-R selector switch described above.
 - (2) With the S-F selector switch in the “Slow” position, the motor shall operate in the forward direction and shall run at the preset low speed set on the VFD HIM when called to run from the PLC or F-O-R selector switch described above.
- d. High speed, low speed, and reverse signals for the motor shall be wired to programmable inputs on the VFD, and the speed for each shall be preset through the drive HIM.
- e. There is a high level start float switch (LSH-10-01) on the upstream side of the screen that shall start the screen in the forward direction at the preset high speed on the VFD HIM (“Auto” mode only). Provide an adjustable time delay relay (0 to 30 seconds) to prevent intermittent starting and stopping due to a bouncing float. The screen shall continue to run in the forward direction at high speed until the float switch is deactivated. The float switch shall be hardwired to the motor control circuit via an intrinsic safety barrier in this control panel.
- f. The motor has internal thermostats that shall shut down the motor in the event of over-temperature (“Hand” and “Auto” modes). Manual reset shall be required to restart the motor. The thermostats shall be wired such that momentary power interruptions do not shut down the motor.
- g. There is an over torque switch (WSH-10-01) furnished with the unit and another emergency stop switch on this control panel that shall be installed by CONTRACTOR where shown on the Drawings. There is an intrinsic safety barrier provided with the unit that shall be dedicated to the over torque switch and installed within this control panel. When an over torque condition is detected, the motor shall shut down (“Hand” mode only) and an alarm shall be activated at the control panel. Manual reset shall be required to restart the motor.
- h. There is a maintained-type emergency stop switch (CS-10-01) at the unit and an additional emergency stop switch on this control panel that shall both be interlocked with the unit such that when a switch is activated, the unit shall shut down (“Hand” and “Auto” modes) and an alarm shall be activated at this control panel. MFS-10-01 shall be reset by resetting the emergency stop switch.
- i. Motor shall be start and ramp up to the associated speed setpoint when called to run in either forward or reverse direction. Coordinate ramp times with motor manufacturer.
- j. All of the above controls shall be hardwired and not through the PLC.

- D. PLC-Based Controls:
1. The Mechanical Fine Screen MFS-10-01 shall be controlled from this PLC as follows:
 - a. There shall be three programmable outputs from the ultrasonic level transmitter “Start Level”, “High Level” and “High-High Level” wired to this PLC such that when any of the outputs are active, the screen shall start and run continuously in the forward direction at the associated speed setpoint. In the event the start level setpoint is active, the screen shall run at the preset low speed setpoint. In the event the high level or high-high setpoint is active, the screen shall run at the preset high speed setpoint. The screen shall continue to run until the associated hardwired signal is inactive and the hardwired adjustable Screen Off Delay Timer (0-10 minutes) has expired.
 - b. There shall be an operator-adjustable “Idle Timer” time delay. Once the Idle Timer has expired, the screen shall start and run continuously in the forward direction at preset slow speed until the Screen Off Delay Timer has expired. The Idle Timer shall reset each time the screen is called to run.
 - c. In the event an over torque condition is detected from the over torque switch, the unit shall shut down for an operator-adjustable shut down time delay (0 to 10 seconds). When the shut down time delay expires, the motor shall start and run in the reverse direction for an operator-adjustable time period (0 to 5 seconds). After this time period, the motor shall shut down for an operator-adjustable shut down time delay (0 to 10 seconds). When the shut down time delay expires and the over torque signal is no longer active, the screen shall return to its previous mode of operation. If the overtorque signal is still active, the PLC shall repeat the reverse/forward cycle for an operator-adjustable number of times (0 to 3 times). If an over torque event is detected again after completing the set number of reverse/forward cycles within an operator-adjustable over torque time period setpoint or if an over torque event is detected while running in reverse, the screen shall shut down and an alarm shall be activated at the SCADA System. The screen shall remain shut down until manually reset at the unit.
- E. Furnish a NEMA 4X control station (CS-10-01) for the screen with the following devices. Control station shall be installed by CONTRACTOR where shown on the Drawings.
1. Local-Off-Remote selector switch.
 2. Forward-Off-Reverse selector switch.
 3. Slow-Fast Selector Switch.
 4. Maintained-type, mushroom-head emergency stop pushbutton.
 5. Reset Pushbutton (VFD Fault, Motor Overtemperature, and Overtorque).
- F. Provide the following instrumentation for monitoring the process control system. Instrumentation shall comply with Section 26 09 00–Controls and Instrumentation and shall be by the same manufacturer provided under Section 26 09 00–Controls and Instrumentation, unless otherwise noted. Coordinate requirements with the Section 26 09 00 System Supplier.
1. Ultrasonic level transmitter (LIT-10-01).
 2. High water level (HWL) float switch (LSH-10-01).
 3. Over torque proximity switch as manufactured by Pepperl + Fuchs NCB15-30M40-N0, or equal (WSH-10-01) to indicate a Screen Jam Alarm condition.

G. Heat Trace:

1. Mechanical fine screen shall be provided with a heat trace system for freeze protection of the debris plate above the top of the screen channel and for the discharge apron, completely factory-installed and -wired, ready to function upon connection of power source from this control panel by CONTRACTOR. Heat trace system shall be suitable for operation in ambient conditions of -25°C (-13°F).
2. Heat-tracing cable shall be supplied to provide 5 W/ft, have a temperature identification number (T-rating) of T6, and be suitable for use with 120 VAC, single-phase 60 Hz supply voltage. Heat-tracing cable shall be Nelson Type LT5, or equal. Heat trace cable shall be installed on the equipment by the manufacturer.
3. Local electromechanical thermostat shall be provided be fluid-filled, ambient air sensing-type with an adjustable setpoint between -10°C and 60°C (15°F and 100°F). Enclosure shall be NEMA 7 and suitable for use in Class I, Division 1, Groups C and D locations. The thermostat shall have a 22 A at 125/250/480 VAC rated, SPDT switch. Thermostat shall be installed on the equipment by the manufacturer, and prewired to the heat trace cable ready to accept 120-volt power from the heat trace to this control panel.
4. Provide manufacturer-recommended installation tape, stainless steel pipe straps and mounting hardware, and all other appurtenances as required by the manufacturer. Power connections shall be specifically designed for the heating cable being supplied and be from the same manufacturer as the heating cable

2.06 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.07 SPECIAL TOOLS

- A. Furnish all special tools necessary to disassemble, service, repair, and adjust the equipment.

2.08 FINISHES

- A. It is the intent of this specification that all equipment, supports and appurtenances shall be furnished shop primed and factory finished. Preparation and painting shall conform to all requirements and provisions specified in Division 09. All surfaces of the mechanical equipment and accessories (except galvanized, stainless steel, rubber, copper, PVC) shall be prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Shop finish system shall consist of two coats of Tnemec 69 Hi-Build Epoxoline II, or equal, applied to a minimum of 5.0 mils dry thickness each. Motors and speed reducers shall be factory primed and finished painted using the manufacturer's standard paint system for corrosive environment and for the specified application.

- B. Stainless steel surfaces shall be bead blasted. After all fabrication and welding has been completed, all stainless steel surfaces shall be glass bead blasted prior to equipment assembly. The bead blast shall remove all weld discoloration and surface contaminants and provide for spontaneous passivation as recognized in ASTM A380-99. Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems, 1. Scope, 1.1.1.1.

2.09 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and two days on site shall be provided for startup and training services.

3.02 INSPECTION, TESTING, AND TUNING

- A. The screen manufacturer shall provide on site services to inspect installation and wiring for equipment provided under this section. Written confirmation of satisfactory installation and termination shall be provided by the manufacturer to OWNER.
- B. Demonstrate system performance per the requirements identified herein to OWNER and/or ENGINEER as a condition of acceptance. Written confirmation of acceptance of the system performance by OWNER shall be provided by the manufacturer to CONTRACTOR.
- C. A minimum of one trip and one day of on-site service shall be provided for testing, start-up, and training services. Equipment manufacturer shall provide personnel to bring equipment to final acceptance as required at no cost to OWNER.

3.03 SYSTEM STARTUP, TRAINING, AND SUPPORT SERVICES

- A. Provide equipment manufacturer's services for the following:
 - 1. Start-up for each item of equipment prior to being placed in service based on the construction sequence.
 - 2. Field testing of each item of equipment prior to being placed in service. Equipment manufacturer shall provide a written report covering checking, testing, inspections and startup and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.
 - 3. Operator training and final adjustment.

- B. Supervision and Start-Up: Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer, and the plant staff shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. A minimum of 4 hours of training shall be provided. OWNER may videotape training presentations given by the manufacturer's representatives. Final payment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.

- C. The manufacturer shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 8 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that this 8 hours shall include one trip to the site.

END OF SECTION

SECTION 46 43 21

SECONDARY CLARIFIER COLLECTORS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installation, and placement into successful operation two secondary clarifier mechanisms (SCD-40-01, SCD-40-02) with scum skimming equipment, and static flocculating feed well, in the new 30-foot-diameter Secondary Clarifiers No. 1 and No. 2. Clarifiers shall be bridge supported. The mechanisms and appurtenances shall be furnished by the same supplier.
- B. Applicable provisions of Division 1 shall govern work in this section.
- C. CONTRACTOR to coordinate Section 06 61 14–Fiberglass Weirs and Baffles, and Section 06 60 12–Launder Cover System.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Each collector for Secondary Clarifiers No. 1 and No. 2 shall be designed for installation in a new 30-foot diameter concrete basin having a side water depth of approximately 14 feet 0 inches.
 - 2. Minimum influent pipe size shall be 10 inches inside diameter.
 - 3. The equipment shall be designed to effectively settle mixed liquor suspended solids and scrape the settled solids from the basin floor to the sludge withdrawal drum. The clarified effluent shall be collected uniformly by the peripheral launder. Surface scum shall be collected by the scum skimming equipment and discharged through the scum withdrawal pipe.
 - 4. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 1/4-inch. All structural steel shall conform to ASTM A-36 requirements and steel plate shall conform to ASTM A283C requirements. All fasteners shall be Type 304 stainless steel.
 - 5. Design Flow Requirements, each clarifier:

	Minimum	Design Average	Peak Hourly
Surface Overflow (mgd)	0.07	0.18	1.08
Return Flow (mgd) RAS	0.09	0.18	0.27
Mixed Liquor Flow (mgd)	0.16	0.36	1.35

6. Clarifier Information:

Tank Diameter 30 feet
Tank Side Water Depth 14 feet
Floor Slope 1 inch per foot

- 7. CONTRACTOR and equipment supplier shall coordinate clearance requirements for the skimmer equipment specified herein.

8. The peripheral access platform and appurtenances shall be provided and coordinated by Division 5 Contractor.

1.03 SUBMITTALS

- A. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2--PRODUCTS

2.01 MANUFACTURERS

- A. Clarifier collector including drive mechanism shall be as manufactured by Ovivo USA, Salt Lake City, Utah; WesTech Engineering, Inc., Salt Lake City, Utah; Evoqua Water Technologies, LLC, Waukesha, Wisconsin, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The drawings and specifications were prepared based on Ovivo USA. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 GENERAL

- A. Clarifier mechanism shall be of the center-drive, spiral blade, scraper type. Mechanism shall include drive mechanism complete with reducer, motor, overload device, influent feed well and supports, access bridge including hand rail and toe plate, center drive assembly and cage or shaft, scraper arms, and surface skimmers with scum trough and ramp. The clarifier shall be designed to remove sludge uniformly from the bottom of the tank.
- B. Clarifier mechanism shall be designed so there shall be no field welding required, except for the bridge splice. The scraper mechanism may be used as the screed for grouting of the tank bottom, provided work is completed in accordance with manufacturer's recommendations.

- C. Submerged metal components shall not be aluminum.

2.03 DRIVE MECHANISM

- A. The center drive assembly shall consist of an integral motor and primary speed reducer coupled through roller chain and sprockets to a secondary final output worm gear reducer and shall have an integral overload protection system.
- B. All gears and bearings shall be oil bath lubricated with the rolling elements of the main bearing totally submerged in oil and the teeth of the worm gear at least partially submerged in the oil bath. The meshing action of the gears shall force the oil onto all surfaces. Oil pumps for lubrication or grease lubricated bearings are not considered appropriate for this application and will not be allowed. The oil reservoir for the main bearing and gear shall have a section of minimum depth 2 inches below the main bearing to positively prevent contamination of the main bearing and gears with condensate or other contaminants. Gear and bearing housings must also be fitted with oil level sight glasses and condensate drains. Condensate must be allowed to drain from a low point of the housing.
- C. Drive components shall be located via a machined, registered fit to preserve the alignment of key drive components under all load conditions. Inspection of the completed drive unit shall be accomplished at the clarifier manufacturer's shop, with reports of all tests and certifications of material hardness being made available for review at ENGINEER's request prior to shipment to the job site.
- D. Major drive components, worm gears and bearings must be designed to allow for separate and individual replacement by plant personnel to facilitate quick and economical repairs.
- E. The complete center drive assembly, including the overload protection device, shall be a regularly manufactured in-house product of the clarifier manufacturer. The center drive assembly is a key element in a successful clarifier installation, therefore drive assemblies purchased from third party vendors will not be accepted.
- F. The gearmotor primary speed reducer shall drive the final worm gear reducer through a #60 roller chain and steel sprockets enclosed in a galvanized 18 gauge steel guard. Sprockets and chain shall be designed for the connected horsepower of the drive with a minimum service factor of 1.4. Provisions shall be made for adjustment of chain tension.
- G. The driven sprocket shall include a shear pin overload to provide overload protection. Directly connected primary reducers, in lieu of chain drive, will not be acceptable.
- H. The final output reducer shall be a worm and worm gear reducer specifically designed for this application. The worm shall be hardened alloy steel.
- I. The worm gear rim shall be solid one-piece centrifugal cast manganese bronze of 65,000 psi tensile strength and have a nominal 21 inch pitch diameter and be supported by and rotate on the main bearing. The rotating center shaft to which the rake arms are attached shall be bolted to the worm gear hub. The gear shall be removable without disturbing the walkway or platform. Gear diameter must be increased in size for cast iron gears.

- J. The main bearing shall have a minimum pitch diameter of 16.25 inches to provide stability without the necessity of underwater guide shoes and shall include chrome alloy steel balls, minimum 0.75 inch diameter, which shall bear vertically and horizontally upon a four point contact precision bearing assembly fitted into the turntable base and the worm gear. The bearing assembly shall be such that the B-10 life of the liner is a minimum of 50 years based on the mechanism speed and a uniformly distributed load due to the rotating mechanism.
- K. The bearing life shall be based on the life to initial pitting of the bearing race.
- L. Drives using integral bearing/gear assemblies will not be allowed. The gear must be replaceable independent of the bearing assembly.
- M. In no case will mechanisms be allowed which use lower guide bearings, feedwell bearings, or have chains, sprockets or any part of the drive unit below the top of walkway beams.
- N. The wormgear and bearing shall be completely enclosed in a housing provided with neoprene dust seals. In order to provide adequate base rigidity, the gear housing shall be of full sidewall construction, integral with the base. Prior to assembly, the base shall be thoroughly inspected for seep holes or inclusions and given a hydrostatic test to insure no leaks are in the oil containment area. Shop inspection reports must be made available for review.
- O. The drive unit shall be equipped with an electro-mechanical overload control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative worm gear output torque on a 0 to 100 percent graduated scale. The 100 percent reading shall equal the 100 percent drive rating as specified below. The control device shall also activate an alarm switch for warning of impending overload, a motor cutout switch for overload protection and a back-up safety motor cutout switch for back up overload protection. A shear pin shall be provided as redundant backup overload protection. The respective switches in the overload control device shall be factory calibrated and set to the following settings:
 - 1. Alarm: 40% of scale.
 - 2. Motor cutout: 85% of scale.
 - 3. Shear Pin: 100% of scale.
- P. All drive control components shall be mounted in a NEMA 4X enclosure of either epoxy coated aluminum construction or stainless steel with a gasket sealed removable cover. The pointer shall be covered with a plexi-glass enclosure and shall be above the walkway surface for visibility from the walkway. Amperage sensing devices are not acceptable for torque overload protection due to their inability to react quickly enough to prevent damage to the drive. Overload devices with exposed linkage connections will not be accepted due to possible corrosion problems.
- Q. The center drive unit shall be designed for the continuous torque rating as specified below. The continuous torque shall be defined as the minimum torque at which the drive mechanism may operate continuously 24 hours per day, 365 days per year, for 20 years, at the specified sludge collector arm speed.

Worm gearing shall be designed and rated to equal or exceed the specified continuous torque and life. The basis for rating shall be ANSI/AGMA 6034-B92 standards for durability rating and design of worm gear reducers.

- R. The drive mechanism torque ratings for the clarifier mechanism shall be:
 - 1. Drive Continuous Torque: 9,000 ft./lbs.
 - 2. Drive 100% design Torque: 15,000 ft./lbs.
 - 3. Drive Momentary Peak Torque: 47,000 ft./lbs.
- S. The complete drive shall be assembled in the clarifier manufacturer shop and tested so that the drive is running properly and to calibrate the drive control. A complete test report shall be sent to ENGINEER verifying that the drive meets the quality assurance of Manufacturer.

2.04 MOTORS

- A. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
- B. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper leads and windings with ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor leads shall have the same insulation class as the windings.
 - b. Rotor bars shall be aluminum.
 - c. Motor shaft shall be high-strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.
 - d. Motors shall be equipped with grease fittings. Bearings shall be prelubricated and field-regreasable. Openings for addition of grease shall have grease fittings provided.
 - 2. Mounting: Vertical.
 - 3. Enclosure: TEFC, rated for Class I, Division 2, Groups C and D locations.
 - 4. Efficiency: Premium efficient as noted in schedule below.
 - 5. Service Factor: 1.15.
 - 6. Power requirements: 60 Hz, three-phase, 230/460-volt, factory-wired for 460-volt connection, $\pm 10\%$ voltage variation.
 - 7. Load type: Constant torque.
 - 8. NEMA Design: B.
 - 9. Insulation: Class F.
 - 10. Nominal operating speed: See motor schedule.
 - 11. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
 - 12. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
 - 13. Accessories:
 - a. Oversized motor junction box.
 - b. Lifting eyes.
- C. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

Clarifier Drive	Horsepower	Nominal Speed	Efficiency	VFD
SCD-40-01	0.75	1,800	85.5%	No
SCD-40-02	0.75	1,800	85.5%	No

2.05 FEED WELL AND INFLUENT PIPE

- A. There shall be provided a 10-inch diameter steel influent pipe, minimum 1/4-inch wall thickness. The pipe shall include a 125 lb. Class ANSI steel flange for bolting to incoming influent line, and shall include an elbow and energy dissipating inlet. The energy dissipating tee at the inlet shall be designed for a maximum inlet velocity of 2 feet per second. The pipe shall include all necessary supports and be located below the rotating feedwell to allow for the rotation of the skimmer assembly.
- B. The feedwell shall be the shape and size required by the manufacturer to meet the design parameters and supported by structural members attached to the center rotating center pier. The feedwell shall be fabricated of 3/16 inch steel plate with upper and lower reinforcing rim angles and stiffeners as required. A minimum of two (2) scum ports, sized as required by the manufacturer to allow scum to exit the feed well, shall be provided equally spaced around the feedwell periphery to allow scum to exit from the feedwell at water level. Scum ports shall be free to allow scum to escape with an angled baffle plate to impart a tangential direction of the flow exiting the scum port.

2.06 CENTER SHAFT AND RAKE ARMS

- A. The center shaft shall be steel pipe, 6-inch Schedule 40. It shall be provided with connection points for the two sludge removal arms and feedwell supports. The shaft shall be bolted to the worm gear to rotate the attached arms, feedwell and skimmer assembly. The minimum angle size used for construction of the arms shall be 2 inch by 2 inch by 1/4 inch members.
- B. The clarifier mechanism shall include two (2) sludge removal arms of steel truss construction, a minimum of 2 feet 10 inches square with steel spiral rake blades and adjustable 20 gauge 304 stainless steel squeegees. The rake blades shall provide complete raking of the basin floor twice per revolution.
- C. The rake blades shall consist of a minimum 3/16-inch thick steel plate. The blades shall be constructed to a logarithmic spiral curve with a constant 30 degree angle of attack. Blade depth shall vary from 6 inches deep at the outer portion of the rake blade, to 15 inches near the tank center. Each rake truss support arm shall be provided with the necessary outrigger bracing and other blade support structures, so that the complete blade can be properly located and adjusted in the field.
- D. The center shaft and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at twice the drive 100% rating.

2.07 SLUDGE WITHDRAWAL DRUM

- A. A rotating sludge collection drum 2 feet diameter by 14 inches deep shall be provided to collect settled solids raked to the center by the rotating spiral blades. The collected sludge shall be discharged from the tank by way of the RAS sludge pipe as shown on the contract drawings.

- B. The sludge collection drum shall rotate with the center cage and shall be provided with sludge collection ports located directly in front of each rotating spiral rake blade. The ports shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration.
- C. The rotating sludge drum shall be constructed of 1/4-inch steel plate. A stainless steel seal shall be provided to seal against the tank floor.

2.08 SKIMMER AND SCUM TROUGH

- A. The clarifier manufacturer shall furnish two skimming devices as part of each clarifier mechanism. Each skimming mechanism shall be arranged to sweep the surface of the sedimentation compartment, automatically removing scum and floating material to a full radius scum trough cantilevered from the tank wall.
- B. Skimmer Construction: Each skimmer arm shall be supported by a suitably designed truss, tube, or pipe assembly connected to the center cage and cantilevered over the scum trough. Tie rods shall be properly located to allow adjustment of the skimmer arm as well as to hold the skimmer in horizontal alignment. Each skimmer arm shall be equipped with a 1/2-inch 60 durometer neoprene wiper blade extending the full width of the scum trough. Steel back-up bars shall be fastened to the back of the wiper with stainless steel fasteners.
- C. Scum Box: The full radius trough shall be supported from the tank wall and fabricated from 1/4-inch steel plate and structural steel angles to form a trough. The scum trough shall span the distance between the feedwell and the scum baffle. The trough and supports shall be designed for a 200 hundred pound point load at the feedwell end of the trough in addition to all dead loads and shall not deflect more than 2 inches in an empty tank. The feedwell end of the trough shall be 6 inches deep and slope down to 20 inches deep on the wall end with a 8-inch Schedule 40 stub pipe. A flexible coupling shall be provided for connection from the 8-inch Schedule 40 stub pipe to the scum withdrawal piping in the tank wall. The front side of the trough shall include a minimum 12-inch wide ramp for removal of scum. The scum is trapped as the wiper meets the ramp and is conveyed up the ramp to be dumped into the scum trough for disposal. The feedwell end of the trough shall have a vertical steel plate extending 1 foot out in front of the ramp to help trap the scum as the skimmer approaches the ramp and to prevent the scum from flowing around the outside edge of the trough. Fabrication of the scum trough shall be true and free from any war page.
- D. Scum Flushing Valve: A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The assembly shall consist of a stainless steel level, UHMW seal plate and neoprene diaphragm mounted to the scum trough. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide zero to twenty gallons of flush water per each pass of the skimmer assembly.

2.09 BRIDGE

- A. An all-welded structural steel access bridge consisting of two wide flange beams shall extend from the tank wall completely across the clarifier as shown on the drawings. The bridge shall consist of a minimum 3-foot (clear) walkway with aluminum grating and span

the entire clarifier tank as shown on the Drawings. The bridge shall be designed to support, in addition to the dead load, a live load of 50 pounds per square foot with a deflection not exceeding 1/360 of the entire span.

- B. Center platform shall be sized to allow access for maintenance on clarifier components as required. Minimum platform size shall be 7-foot square.
- C. Aluminum railing, grating, toe plate, and checkered plate shall be provided by Division 05 Contractor, but shall be detailed by equipment supplier.

2.10 WEIR, BAFFLE AND MISCELLANEOUS

- A. Effluent weirs and scum baffles complete with anchors and brackets shall be furnished by Division 06 CONTRACTOR. Launder covers shall be provided by Division 06 CONTRACTOR. Details of the weirs and baffles to show locations and elevations required by the equipment, including scum beach connecting shall be provided by the clarifier manufacturer to Division 06 and 13 CONTRACTORS. The weirs shall be as shown on the drawings. CONTRACTOR shall coordinate between clarifier equipment, weir and baffle manufacturer, and launder cover manufacturer system requirements.
- B. All parts of the mechanism shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent or continuous operation. Workmanship shall be of high grade in all respects.
- C. Scum Baffle: The baffle shall consist of 1/4-inch thick by 12-inch deep fiberglass sections. In the area of the scum box the scum baffle shall extend to 24 inches starting approximately 6 feet before and ending 2 feet after the scum box. The baffle sections shall be curved and fastened to the launder wall with adjustable FRP support brackets, stainless steel fasteners, and anchor belts.

2.11 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR as part of this contract.

2.12 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop-priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline or Tnemec 140-1255 Beige Pota-Pox primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. All gear boxes, motors, and controls shall be painted in

accordance with Division 09, except polished shafts which shall be heavily coated with grease. Chains shall be coated with slush oil.

- B. In addition, the following parts shall receive two shop finish coats of Themec 69 Hi-Build Epoxoline II, or equal, (5.0 DMT ea.) paint as specified in Division 09 under submerged steel: a) influent pipe, b) scraper rake truss assembly, and c) center shaft (both inside and outside of tube). Paint manufacturer and product reference number shall be the same as that provided by CONTRACTOR under Division 09 for compatibility and touch-up in the field.

2.13 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be Type 316 stainless steel and shall be of ample strength for the intended service. Provide anchor bolts in accordance with Division 05. All anchor bolts shall be set by CONTRACTOR in accordance with the manufacturer's instructions.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for field installation, testing, quality assurance, and startup.

3.02 FIELD TESTING

- A. The collector mechanism shall be field tested after erection and in the presence of ENGINEER to confirm the structural and mechanical compliance to the torque requirements specified by loading each collector mechanism with 100% and 120% of rated AGMA continuous torque specified (alarm torque). This field test shall substantiate operation of warning and drive shutdown circuitry.
- B. Complete test procedures shall be submitted to ENGINEER prior to testing; however, testing shall be accomplished with the machine in operation. Loads shall be applied to the mechanisms' structural arms through cables or be applied by means of a hydraulic cylinder. Gauges shall be used to assess the torque
- C. All labor, materials, and test apparatus necessary for conducting the above tests shall be furnished by this CONTRACTOR and included in the Lump Sum Bid.
- D. No static tests shall be acceptable; tests shall be conducted with the drive running.

END OF SECTION

SECTION 46 51 21

COARSE BUBBLE MIXING ASSEMBLIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation a coarse bubble diffused aeration system in the sludge storage tank. The equipment shall consist of coarse bubble elastomeric diffusers, drop pipes, air header/manifold piping, piping supports, and other appurtenances. All equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: The aeration equipment shall be used to aerate and mix waste activated sludge at up to 2% solids concentration while maintaining solids in suspension. The equipment shall be installed in the sludge storage tank (Structure 70) as shown on the drawings.
- B. Performance Requirements:
 - 1. The aeration equipment manufacturer shall furnish diffuser elements to meet the following requirements:

Tank	Length (ft)	Width (ft)	Maximum Side Water Depth (ft)	Normal Operating Depth (ft)	Minimum Side Water Depth (ft)
Structure 70	26	12	10	10	6.5

- 2. The aeration system shall be sized to provide an air rate per tank of 35 scfm per 1000 cubic feet based on the operating depth.

Tank	Volume Per Tank (cf) at maximum op. depth	Air Rate Per Tank (scfm) at maximum op. depth
Structure 70	3120	109.20

Manifold Assembly Model	M-6
Drog Leg Size	3-inch
Number of Drop Legs	4
Number of Diffusers per Manifold	4
Max Capacity Per Diffuser	48 scfm
Airflow Rate	8.19 scfm
Connection Method	Flanged (Type 3)

1.03 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. The coarse bubble diffused aeration system shall be Model TFA-1.5 Tideflex Technologies (a Division of Red Valve Company), Pittsburgh, PA, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The drawings and specifications were prepared based on Tideflex Technologies. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 COARSE BUBBLE ELASTOMERIC DIFFUSERS

- A. Diffuser Construction and Performance:
 - 1. The diffuser shall be capable of preventing backflow of the process liquid into the diffuser and distribution piping through the diffuser air emittance opening when the discharge airflow is shut off.
 - 2. The diffuser shall be capable of complete submersion in a sludge blanket of minimum 2 percent solids concentration with zero airflow through the diffuser without causing clogging of the diffuser discharge opening or misalignment of the diffuser original orientation. The diffuser shall be capable of operating in an on-off blower operation mode without clogging of the diffuser.
 - 3. All elastomer components shall be constructed of EPDM synthetic elastomer with a leachable oils content of 10 percent or less. Elastomer components shall be clamped to a bushing or pipe nipple with 304L SS heavy duty clamp.
 - 4. Automatic Condensate Removal: The system must be capable of automatic purging of accumulated condensate within the manifold piping.
 - 5. The diffusers shall be connected to the distribution piping with a threaded or flanged connection. Threaded connection material shall be minimum schedule 40, 304L stainless steel. Flanged connection shall utilize 304L SS hardware.

2.03 DIFFUSED AERATION PIPING EQUIPMENT

- A. Stainless Steel Pipe Materials:
 - 1. All stainless steel pipe components shall be schedule 10 304L and shall be passivated by complete immersion in nitric-hydrofluoric acid according to ASTM A380 and shall be passivated after any welding.
 - 2. Grooved joint couplings do not require passivation.

- B. Piping Support Brackets:
 - 1. Vertical Piping: All components of the bracket assembly shall be 304L stainless steel. The assembly support bracing shall be anchored to the concrete wall epoxy adhesive anchoring; the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section. All welded structural components of the assembly shall be passivated.
 - 2. Lateral Piping: All component of the bracket assembly shall be 304L stainless steel. Lateral support brackets shall allow for a minimum of 2 inches adjustment in elevation of the lateral pipe. Assembly components shall consist of two riser-type clamps, two all-thread rods, one neoprene strip equal to the lateral pipe circumference, and 316L stainless steel lock nuts with integral nylon ring. Threaded rods shall be anchored to the concrete floor using epoxy adhesive anchoring.

- C. Stainless Steel Welding: All welding of pipe and structural support members shall be conducted at the factory using TIG, MIG, inert gas or plasma-arc welding methods. Field welding will not be permitted without approval of ENGINEER. All welded components shall be passivated. Weld cross sections shall have a thickness equal to or greater than the welded material. All butt welds shall be fully penetrated with gas shielding to the interior and exterior of the joint. All face rings and flanges shall be continuously welded on both sides unless lap joint flanges are specified.

- D. Vertical Air Supply Piping:
 - 1. Vertical air supply piping shall be a minimum of Schedule 10, 304L stainless steel.
 - 2. The top of the drop pipe shall be equipped with a 3-inch flange for connection to a 3-inch flange on the air supply header.
 - 3. Each drop pipe shall be equipped with a stainless steel lifting lug capable of sustaining twice the static weight of the entire manifold assembly.
 - 4. 304L Stainless steel bolts, nuts, and EDPM gasket rated for minimum 250°F shall be provided for field connection of each vertical pipe to the nonwetted field-routed air supply piping at the top of the tank.

- E. Lateral Air Distribution Piping: Lateral air distribution piping shall be a minimum Schedule 10, 304L stainless steel.

- F. Pipe Joints:
 - 1. All pipe joints that are to be field connected shall be flanged.
 - 2. Flanged connections shall be Class 150 and in accordance with ANSI bolt diameter and hole spacing standards. Flange material shall be either stainless steel to match the associated pipe material. Bolts and nuts shall be a minimum of 316L stainless steel. Gasket material shall be EPDM elastomer rated at 250°F minimum.

- G. Pipe Cleanouts:
 - 1. Full diameter pipe cleanouts shall be provided at the end of each lateral distribution pipe.

2. Cleanout shall be a coupled end cap or blind flange connection.

- H. Mechanical couplings shall be Style 489 rigid stainless steel conforming to ASTM A-351, A-743, and A-744 Grade CF-8M. (Rigid coupling key shall clamp the bottom of the groove.) Mechanical coupling bolts and nuts shall be Type 316 stainless steel oval neck track bolts and heavy hex nuts with chemical and physical properties of ASTM A-193, Grade B8M, Class 2 or ASTM F-593, Group 2, Condition CW.
- I. Gaskets for grooved couplings shall be Grade "E" EPDM compound (green color coded) conforming to ABSI/NSF 61 for cold and hot water service operating temperatures up to +180°F.
- J. Fitting and coatings shall be smooth turn, full flow, stainless steel Victaulic fittings conforming to ASTM A403 or factory-segmentally welded fittings from stainless steel pipe conforming to ASTM A312 with grooves designed to accept Victaulic grooved end couplings.

2.04 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.05 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the 2017 Ohio Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

2.06 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of two trips, two days each on site shall be provided for startup and training services.

3.02 EQUIPMENT INSTALLATION AND COORDINATION

- A. Install equipment in accordance with manufacturer's recommendations. Set headers plumb and level and provide uniform spacing of diffusers and supports.
- B. All diffuser elements shall be installed level to a tolerance of $\pm 3/8$ -inch at a common horizontal plane. Each tank shall be flooded with plant water to the tops of the diffusers. The level of all the diffusers shall then be checked by CONTRACTOR so they are at the same elevation $\pm 3/8$ -inch.

3.03 STARTUP AND TESTING

- A. CONTRACTOR shall provide water and any temporary equipment and piping necessary for testing. CONTRACTOR shall be responsible for all installation and removal of temporary testing equipment and for all testing.
- B. Uniformity and Leakage Tests: The sludge holding tank shall be flooded with water (potable, non-potable, or WWTP effluent are acceptable) to a depth approximately 1 foot above the tops of the diffusers. Process air shall be supplied evenly to all headers in each tank. The surface of the water above the diffusers shall then be visually observed so that air flow is uniformly distributed.

END OF SECTION

SECTION 46 51 46

MEMBRANE DIFFUSERS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
1. This section includes furnishing, installing, and placing into successful operation a fine-bubble membrane disk aeration system in the aeration tanks.
 2. This section includes furnishing, installing, and placing into successful operation a fine-bubble membrane disk aeration system in the postaeration tank.
 3. The equipment shall include drop pipes, submerged air manifolds and supports, distribution headers and supports, factory-installed diffuser element holders and diffuser element retainers, gaskets, and orifice and membrane diffuser elements. The equipment shall also include fixed joints, bolts, nuts, and gaskets for flanged joints, stainless steel anchor bolts for supports, and drain line, sump, and airlift purge system.
 4. All equipment shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Application:
1. The aeration tanks are activated sludge tanks receiving a mixture of return activated sludge and raw wastewater.
 2. The postaeration tank receives secondary effluent.
- B. Design Requirements: Air diffusion piping and diffusers shall be capable of delivering 200% of the design air rate specified. The proposed aeration systems shall be designed with provisions for expansion and contraction in all members.
- C. Performance Requirements:
1. Aeration Tanks : The equipment manufacturer shall furnish diffuser elements to meet the following requirements in the aeration tanks.
 - a. SWD varies, 11.49 feet to 11.87 feet (because of headlosses through aeration tanks).
 - b. Maximum top of diffuser submergence 11.12 feet.
 - c. Transfer 1,213 pounds of O₂ per day per aeration tank at 14.7 psia, 2.0 mg/L dissolved oxygen concentration, 20°C, clear water (standard conditions).

AERATION TANKS

Item	No. 1	No. 2	No. 3
Surface area of aeration tank	750 ft ²	750 ft ²	750 ft ²
Maximum air per tank	168 scfm	168 scfm	168 scfm
Maximum air per diffuser	4.0 scfm	4.0 scfm	4.0 scfm
Diffusers per tank installed*	42	42	42
PSI required at drop	6.09	6.09	6.09

*Manufacturer shall provide additional diffusers as necessary for proposed design.

2. The equipment manufacturer shall furnish diffuser elements to meet the following requirements in the Postaeration Tank.
 - a. SWD varies 6.5 feet to 7.35 feet.
 - b. Maximum diffuser submergence 6.6 feet.
 - c. Transfer the following pounds of O₂ per day at 14.7 psia, 0 mg/L dissolved oxygen concentration, 20°C, clear water (standard conditions), and the parameters contained in this section.

POSTAERATION TANK

Item	No. 1
Surface area of postaeration tank	86.25 ft ²
Maximum air in postaeration tank	69 scfm
Maximum air per diffuser	4 scfm
Diffusers installed	18
PSI required at drop	6

1.03 WARRANTY

- A. Standard 1-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC14.04 and 14.05, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.04 SUBMITTALS

- A. Manufacturer shall provide heat loss calculations demonstrating the air temperature of the blower discharge shall be below the temperature rating of the manifold, air distribution system, and diffuser elements.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The diffuser element shall be membrane disk, as manufactured by Sanitaire a Xylem Brand of Brown Deer, Wisconsin, Aquarius Technologies of Port Washington, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The drawings and specifications were prepared based on Sanitaire. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including but not limited to structural, mechanical, and electrical work.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 DROP PIPE AND MANIFOLD

- A. Type 304 stainless steel drop pipes shall extend from the air main piping at the top of the tank, above the water surface, to a 304 stainless steel dropleg section and air manifold below the water surface for the Aeration Tank.
- B. Type 304 stainless steel drop pipes shall extend from the air main piping at the top of the tank, above the water surface, to a Schedule 40 PVC dropleg section and air manifold below the water surface for the Postaeration Tank. The drop pipes shall be supported from their upper connection. The top connection shall be a loose follower flange.
- C. For the Postaeration Tank, the stainless steel drop pipes shall extend to within 3 feet above the manifold. The remainder of the drop pipe and the manifold shall be PVC of the material specified for the distribution system.
- D. Each section of the submerged air manifold shall have a minimum of two supports. Maximum support spacing shall be 8 feet. Manifold supports shall meet the expansion-contraction requirements as described in these specifications. The diameter and invert elevation of the submerged air manifold shall be the same throughout the tank. Each end of the submerged manifold shall have a welded end cap.
- E. Connections between sections of the submerged air manifold shall be special joints. These joints shall be designed so that individual manifold sections can be rotated independently of adjacent manifold sections for alignment purposes.
- F. The submerged air manifold shall include an expansion-contraction system consisting of guide supports, fixed supports, and positive locking joints. The fixed supports shall provide no movement. Guide supports shall allow longitudinal movement. The entire system shall allow for expansion and contraction over a range of 125°F.
- G. Manifold supports shall include manifold hold-down, adjusting and locking mechanism, cradle, and supporting structure. Stainless steel cinch-type anchor bolts shall secure the stainless steel stand to the tank floor.
- H. Each manifold support shall have a cradle with a bearing surface contoured to fit a minimum of the bottom 90 degrees of the air distribution manifold. The cradle surface shall be a minimum of 2 inches wide. All supports shall include a mechanism to provide for a minimum of ± 2 inches vertical and $\pm 1/2$ -inch lateral adjustment for alignment of the manifold. All adjusting devices and mechanisms shall lock to maintain the manifold in position after the final adjustments have been made.
- I. Connections shall be provided along the horizontal or side centerline of the submerged air manifold for connection to the air distribution headers.
- J. All welded parts and assemblies, including drop pipes, fabricated supports, flanged joints, and expansion joints shall be fabricated from sheets and plates of 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240-78a. Other nonwelded parts and pieces such as bolts, washers, and follower flanges shall be made of 304 stainless steel. The nuts shall be 18/8 stainless steel. All anchor bolts shall be 304 stainless steel.
- K. For the Postaeration Tank, the connection between the stainless steel portion of the drop leg and the PVC portion of the drop leg shall be by a stainless steel clamp-type coupling supplied by the aeration equipment manufacturer.

- L. Drop leg gaskets shall be 45 to 55 durometer neoprene. All 304L stainless steel material shall conform to the chemical requirements of ASTM 240-78a and AISI 304L, except that the maximum carbon content shall be limited to 0.030%.
- M. The drop legs shall be a minimum of 12 gauge wall thickness and dimensional tolerances shall conform to ASTM A554-72 and ASTM A530-72. All drop legs shall be 8-inch diameter in the aeration tank and 4-inch diameter in the postaeration tank.
- N. All welding shall be completed in the factory. Field welding shall not be permitted. All welding shall be by the shielded arc, inert gas, MIG, or TIG method. Filler wire shall be added to all welds to provide for a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint. Flanges and face ring welds shall be continuous on both sides.
- O. Interior bead welds shall be smooth, evenly distributed with an interior projection not exceeding 1/16 inch beyond the i.d. of the air header or fitting.
- P. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.
- Q. After fabrication, all stainless steel assemblies and parts shall be passivated by immersion in a pickling solution of 10% nitric acid and 3% hydrofluoric acid at 140°F for a minimum of 15 minutes in water. Parts shall be free of iron particles or foreign material. A complete wash in hot water shall be required.

2.03 DISTRIBUTION SYSTEM

- A. The distribution headers shall include header piping support stands, factory-installed diffuser element holders, positive fixed threaded union joints or flanges, drainage system, and anchor bolts. Push-on or bell-in-spigot-type joints shall not be acceptable.
- B. The distribution headers shall connect to the horizontal or side centerline of the manifold at the connections provided for that purpose. The headers shall be fabricated in sections not to exceed 25 feet in length. Joints between sections shall permit rotation of each header section independently of adjacent header sections. The fixed union shall consist of a spigot section with grooves solvent welded to one end of a header, a threaded socket section with splines solvent welded to the mating header, an O-ring gasket, and a threaded screw-on retaining ring. The fixed union shall provide a rigid connection between headers and shall prevent rotation of either of the pipes. In lieu of the fixed union described above, flanges with 150 pound drilling shall be used to connect header pipes in accordance with ASTM standards for the specified header pipe.
- C. Each header section shall be anchored in place by either fixed or intermediate supports. Intermediate supports shall allow longitudinal and rotational movements of the header section. The distribution header supports in each aeration tank shall be spaced at a maximum of 7-foot intervals. Stands shall be adjustable to permit leveling and rotating of the distribution header. All adjusting devices shall lock in place after the headers have been installed and leveled. Each support shall be secured to the tank floor by means of an expansion-type anchor bolt designed for four times the calculated normal uplift forces. All header supports shall have a vertical adjustment of $\pm 1 \frac{1}{2}$ inches.
- D. The air distribution systems shall be designed for expansion-contraction over a temperature range of 125°F.

- E. The fixed supports shall be designed to anchor the PVC header against longitudinal movements at the supports. The fixed support shall be attached to the header to prevent movement at this point. Any expansion-contraction must take place through the guide supports.
- F. Diffuser assemblies shall be installed along the top centerline of the distribution header. Each diffuser assembly shall consist of a holder, gasket, retainer ring, orifice control, and diffuser element.
- G. The entire system shall be designed, manufactured, and installed so that all the diffuser elements are within $\pm 1/8$ inch of a common horizontal plane. Air distribution shall be uniform throughout the entire system and shall be uniform over the entire horizontal projected surface of each diffuser element.
- H. The diffuser element holder shall be factory bonded to the distribution header. The diffuser element shall fit into the diffuser element holder and shall be secured by a retainer ring that shall be screwed onto the element holder. A gasket integral to the membrane diffuser shall be fitted into an annular space formed by the diffuser base plate and the diffuser holder. The gasket shall form a seal between the diffuser base plate and the diffuser holder.
- I. Air shall enter the diffuser assembly from the distribution header through the orifice control. The orifice control shall be of a size to provide adequate air distribution throughout the system and the air release of the orifice shall be designed such that air entering the diffuser assembly shall be distributed under the surface of the diffuser element.
- J. The diffuser element shall be a Silver Series, or equal, membrane disk and shall diffuse air in a fine-bubble form. Diffuser elements for aeration tanks shall be SSLP, low pressure, or equal. Diffuser elements for post-aeration tank shall be Silver Series II, low pressure, or equal. Diffusers shall provide uniform distribution and release of air bubbles across the active surface of the diffuser element when submerged through precision die-formed slits. Membrane diffusers shall not require a center bolt to limit membrane deflection. Membranes shall collapse and seal to base plate when no air is passing through the diffuser.
- K. A water purge piping system shall be provided to drain each submerged aeration tank and post-aeration tank piping system. The vertical purge system shall be PVC.
- L. Distribution headers, joints, diffuser holders, and retainer rings shall be manufactured of UPVC with a minimum of 2% TiO₂ added for ultraviolet protection.
- M. Headers shall be nominal 4-inch diameter and shall conform to ASTM D3034 and shall be Schedule 80. Fixed joints, diffuser holders, and retainer rings shall have a minimum wall thickness of 0.125 inches. Header sections shall not exceed 25 feet in length and shall have a minimum wall thickness of 0.125 inches. Fixed joints and diffuser element holder shall be factory-installed on the distribution header. No field solvent welding shall be permitted. Supports shall be of stainless steel and shall meet the material requirements specified for manifold supports.

2.04 DIFFUSER ELEMENTS

- A. Circular membrane diffuser disks shall be manufactured of EPDM synthetic rubber compound with precision die-formed slits. Thermoplastic materials such as plasticized PVC or polyurethane shall not be acceptable.

- B. Diffusers shall be free of tears, voids, bubbles, creases, or other structural defects.
- C. For diffuser assemblies with a single diffuser, the maximum spacing between diffuser elements shall not exceed 4 feet. For diffuser assemblies with two diffusers, the maximum spacing between diffuser elements shall not exceed 6 feet.
- D. Diffuser shall be a one-piece compression molded part with a minimum thickness of 0.080-inch for nominal 9-inch-diameter unit. This part thickness shall limit the maximum tensile stress of the rubber membrane to 10 psi when operating at 2.4 scfm per square foot of membrane media. Larger disk diffusers shall be proportionally thicker to limit the maximum tensile stress at the specified air rate.
- E. The EPDM rubber compound shall have the following minimum characteristics:
 - 1. Durometer: 60 Points \pm 5.
 - 2. Tensile Strength: 1,200 psi.
 - 3. Elongation: 400%.
 - 4. Specific Gravity: 1.25 or less.
 - 5. Base Polymer: EPDM.
 - 6. UV Resistance: Carbon Black.
- F. In addition to the above characteristics, the compound shall be "oven aged" for 70 hours at 70°C according to ASTM D573, the durometer shall not change by more than 10 points; the tensile strength shall not change by more than 25%; and the elongation shall not change by more than 25%. Maximum allowable compression set of the compound shall be 50% or less in accordance with ASTM D395 Method B. The compound shall also pass the low temperature brittleness test, ASTM D2173, and the ozone resistance test, ASTM D1171. Submit laboratory results of the EPDM compound to show compliance with these requirements.
- G. Furnish diffuser membranes with uniform distribution of air bubble release across the active surface of the diffuser element when submerged in water. Membrane disks shall be manufactured with integral sealing gaskets.
- H. Furnish membranes to meet or exceed the following criteria:
 - 1. Membrane shall collapse and seal when aeration system air is turned off.
 - 2. Membrane shall be able to collapse onto support base when air is not being diffused.
- I. Furnish diffuser assemblies consisting of a diffuser membrane with integral gaskets, diffuser holder, support base, air control orifice, and retaining device. Diffusers utilizing ceramic or plastic-type diffusion media elements will not be acceptable as alternative to the membrane disk design. Diffusers that require a center bolt to limit membrane deflection will not be allowed.
 - 1. Furnish PVC diffuser element holders with an air plenum below the diffuser support plate. Provide a mechanism to attach the diffuser to the holder.
 - 2. Element holders shall provide complete peripheral edge support for the membrane diffuser element.
 - 3. Solvent weld element holders to the distribution headers in the factory to resist a dead load of 200 pounds applied vertically to the outer edge of the diffuser unit.
 - 4. Furnish retaining device to securely hold and seal the membrane diffuser to the holder.
 - a. Design diffuser assembly and retaining device to prevent air escape at the diffuser element-sealing gasket interface. Make gasket integral with diffuser element.
 - b. Prove a method to vary the applied sealing force between the sealing gasket to provide a long-term positive seal and prevent air escape except through the active area of the diffuser membrane.

5. Provide screw-on retainer rings with a positive O-ring seal and a minimum of 2 1/2 complete threads for engagement. Threads shall have a minimum cross section of 1/8 inch. Alternatives utilizing a threaded nipple design for attaching the diffuser to header must use stainless steel nipples and stainless steel inserts molded into the PVC headers.

2.05 IN-PLACE MONITORING SYSTEM

- A. Provide monitoring system to measure the dynamic wet pressure and operating air flow rate of a typical diffuser in the each aeration tank and the postaeration tank. Furnish one portable monitoring panel in a fiberglass enclosure (NEMA 4X) with stainless steel handrail bracket. Provide monitoring panel with differential pressure gauges (orifice and diffuser), PVC ball valves, quick coupling connectors, and two sets of calibration curves. Furnish one fiberglass pressure monitoring connecting box with mounting for handrail and carrier column assembly for the aeration tanks and the postaeration tank (four total). Design monitoring system for monitoring of air distribution header pressure, flow control orifice differential pressure, and diffuser element operating differential pressure (DWP).

2.06 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation quality control, testing, supervision, start-up, and operator training. Comply with additional requirements as specified below.

3.02 PREPARATION

- A. Equipment shall be installed in aeration tanks while tanks are empty. CONTRACTOR shall coordinate equipment installation with the construction sequence.

3.03 FIELD TESTS

- A. CONTRACTOR shall conduct field tests in each aeration tank and the postaeration tank once the diffuser system has been installed. The equipment manufacturer shall be present. At least two days prior to the performance of field tests, CONTRACTOR shall notify ENGINEER in writing when these tests are to be performed. CONTRACTOR and ENGINEER shall agree upon the actual time that the tests are to be performed. CONTRACTOR shall furnish all labor, equipment, and materials required to perform the tests. CONTRACTOR shall provide necessary piping from existing plant water system to flood aeration tank and postaeration tank. All defects shall be corrected by CONTRACTOR and all required retesting shall be performed by CONTRACTOR at no additional cost to OWNER.
 1. Level Test: Each aeration tank and the postaeration tank shall be flooded with plant water to the tops of the diffusers. The level of the diffusers shall then be checked to so that they are at the same elevation within ± 0.125 inch.
 2. Uniformity and Leakage Tests: Each aeration tank and the postaeration tank shall be flooded with plant water to a depth approximately 1 foot above the tops of the

diffusers. Process air shall be supplied evenly to all headers in each tank. The surface of the water above the diffusers shall then be visually observed so that there are no leaks and air flow is uniformly distributed across the tank.

END OF SECTION

SECTION 46 66 56

ULTRAVIOLET DISINFECTION SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation a complete open channel, gravity flow, ultraviolet (UV) disinfection system UV-60-01 with one bank of UV lamps. The system shall be complete with UV modules, power distribution system control, UV monitoring system, and all related components as shown on the drawings and specified herein. The UV disinfection equipment, module cleaning rack, storage rack, davit crane, and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The UV Disinfection system shall be designed to disinfect wastewater plant effluent with the characteristics described herein.
 - 2. The system design shall provide full length immersion of UV lamps in effluent flow with the use of a fixed effluent weir system for water level control installed downstream of the UV banks. The system design shall allow complete system shutdown or bypass and shall be capable of continuing disinfection while UV lamps, lamp sleeves, and ballasts are replaced and/or maintained.
 - 3. Lamp electrodes shall be operated at the same temperature and cooled by effluent media, with the major axis of UV lamps set parallel to flow.
- B. Performance Requirements:
 - 1. The equipment provided shall disinfect a wastewater effluent with the following characteristics:
 - a. Minimum daily flow: 0.07 MGD.
 - b. Average daily flow: 0.18 MGD.
 - c. Peak hourly flow: 1.08 MGD.
 - d. Type of effluent: clarified secondary effluent.
 - e. Total suspended solids (monthly average): 30 mg/L.
 - f. Five day BOD (monthly average): 8.7 mg/L.
 - g. Annual effluent temperature range: 33 to 85°F.
 - 2. Minimum UV transmittance @ 253.7 nm: 65%
 - 3. Effluent standards to be achieved: 126 fecal coliform/100 mL (geometric mean).
 - 4. Based on information from Trojan Technologies, the system supplied shall be arranged in the following manner:
 - a. Maximum depth downstream UV banks: 1.04 feet.
 - b. Minimum depth downstream UV banks: 0.92 feet.
 - 5. The head loss through the UV system shall not exceed 1.75 inches at flow of 1.08 MDG. This head loss includes UV modules, including any lamps and any framework, baffle plates, weir, and any other equipment restrictions that may be provided with the system.

6. The EPA UV dose produced by the system shall not be less than 30,000 $\mu\text{Ws}/\text{cm}^2$ after one year (8,760 hours) of lamp operation measured in an effluent with a 65% UV transmission at 253.7 nm and with lamp output at 80% of its initial level after one year of operation and after cleaning has been completed. A fouling factor of -0.7 (for manual cleaning) shall be used when calculating the dose.
7. Dose calculation shall be in accordance with the bioassay validation method as described in applicable sections of the US EPA design Manual-Municipal Water Disinfection (EPA/625/1-86/021) without exceptions.

1.03 QUALITY ASSURANCE

- A. Provide evidence of previous performance by submitting the following information and samples to ENGINEER:
 1. Operational data from a minimum of three installations using its wastewater disinfection with lamps parallel to the flow in a uniform array in an open channel and utilizing the same method of level control as shall be furnished on this project.
 2. These systems shall have been disinfecting at least 1.1 MGD secondary effluent with similar parameters to the Sycamore Trails WWTP for at least 24 months. This documentation shall include twelve consecutive months of data demonstrating that the disinfected effluent quality was below effluent standards to be achieved as specified in this specification sections (see 1.02.3.B) at a UV dose less than or equal to that of which shall be produced by the proposed system.
 3. These conditions shall be documented by a laboratory independent of the manufacturer.

1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.
- B. UV lamps shall be warranted for 12,000 hours (non-prorated) or 36 calendar months from shipment, whichever comes first.

1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. The UV disinfection system shall be the UV 3800K PTP as manufactured by Trojan Technologies, Wedeco Inc., or equal. UV Lamp Module Cleaning Rack and Storage/Support Rack shall be as supplied by Trojan Technologies, or equal. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

- B. The drawings were prepared based on Trojan Technologies. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.
- C. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.02 GENERAL

- A. Based on the information from Trojan, the system shall consist of a bank to be installed in a channel and arranged in the following manner:
 - 1. Number of Banks: 1
 - 2. Number of UV Modules: 8
 - 3. Number of Monitoring Panels: 1
 - 4. Number of Power Distribution Receptacles: 4
 - 5. Number of Lamps: 32
- B. Based on the information from Trojan, channel dimensions in the area of the UV modules shall be as follows:
 - 1. Channel width: 24 inches.
 - 2. Nominal water depth: 11.04 inches.
 - 3. Minimum channel length (excluding weirs): 150 inches.
 - 4. See drawings for additional dimensions and tolerances.
- C. The lamp array configuration shall be a uniform array with all lamps parallel to each other and to the flow. The lamps shall have equal centerline spacing along the horizontal and vertical axis. The single array pattern shall be continuous and symmetrical throughout the reactor.
- D. The system shall be designed for complete immersion in the effluent of the UV lamps within their protective quartz sleeve. Both electrodes and the full arc length of the lamp shall be below the water surface. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent. Systems designed whereby the lamps are inserted through a metallic bulkhead or which otherwise prevent uniform cooling of the lamp electrodes (e.g., vertical lamp systems) by the effluent shall not be permitted.
- E. The UV system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, and ballasts.

2.03 EQUIPMENT COMPONENTS, MATERIALS, AND CONSTRUCTION

- A. All metal components in contact with the effluent shall be at a minimum Type 316L stainless steel.

- B. All metal components located in or directly on top of the channel shall be constructed of 304 stainless steel, with the exception of the ballast enclosure, which shall be constructed of anodized aluminum.
- C. All wiring exposed to UV light shall be Teflon-coated or other suitable long-term resistant materials.
- D. All materials exposed to UV light shall be 316 stainless steel, quartz glass, Teflon, Viton, or other suitable long-term UV-resistant materials.

2.04 UV MODULE

- A. Each UV module shall consist of UV lamps with an electronic ballast enclosure mounted on a Type 316L stainless steel frame.
- B. Each lamp shall be enclosed in its individual quartz sleeve, one end of which shall be closed and the other end sealed by a lamp end seal.
- C. The closed end of the quartz sleeve shall be held in place by means of a retaining O-ring. The quartz sleeve shall not come in contact with any steel in the frame.
- D. The ends of the lamp sleeve shall not protrude beyond the stainless steel frame of the UV Module.
- E. Lamp wires shall terminate in the electronic ballast enclosure located at the top of the UV Module.
- F. All lamp to ballast connections shall be made by and tested by the UV Manufacturer.
- G. The electronic ballast enclosure shall contain the electronic ballasts and lamp status shall be displayed on top of each UV module using watertight LED indicator lights.
- H. Each UV Module shall be provided with a standard 120 volt plug and 10-foot weatherproof cable for connection to a GFI receptacle.
- I. At the point of exit from the UV Module frame the multiconductor cable shall pass through a waterproof strain relief.
- J. Each UV Module shall have a rating of NEMA 6P.

2.05 UV LAMPS

- A. Lamps shall be high intensity low pressure amalgam design and shall be rated for 250 watts at full power. The lamp shall be preheated to promote longevity. Lamps that are not amalgam or that are based on driving a low pressure lamp at an amperage greater than 500 milliamps will not be allowed.
- B. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
- C. Electrical connections shall be at one end of the lamp and have four pins, dielectrically tested for 2,500 volts. Lamps that do not have 4 pins shall be considered instant start.

- D. Lamps shall be rated to produce zero levels of ozone.
- E. Lamps shall be operated by electronic ballasts with variable output settings.
- F. A dual source of supply shall be available for replacement lamps.
- G. Lamp manufacturer shall dispose of returned lamps (old/used) at no cost to OWNER upon receipt of returned lamps at the manufacturing headquarters.

2.06 LAMP END SEAL AND LAMP HOLDER

- A. The open end of the lamp sleeve shall be sealed by means of a sleeve nut which threads onto a sleeve cup and compresses the sleeve O-ring.
- B. The sleeve nut shall have a knurled surface to allow a handgrip for tightening. The sleeve nut shall not require any tools for removal.
- C. The lamp shall be held in place by means of a molded lamp holder that incorporates two seals. The lampholder shall incorporate a double seal against the inside of the quartz sleeve to act in series with the external O-ring seal.
- D. The second seal on the lampholder shall isolate and seal the lamp from the module frame and all other lamps in the module.
- E. In the event of a quartz sleeve fracture the two seals of the lampholder shall prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.
- F. The lampholder shall also incorporate a UV resistant PVC molded stop that shall prevent the lamp sleeve from touching the steel sleeve cup.

2.07 UV LAMP SLEEVES

- A. Quartz sleeves to be Type 214 clear fused quartz circular tubing as manufactured by General Electric, or equal.
- B. Quartz to be rated for UV transmission of 89% and not subject to solarization.
- C. The nominal wall thickness will be 1.0 to 2.0 mm to maximize UV transmission.
- D. Lamp sleeves shall be domed at one end.

2.08 LEVEL CONTROL WEIR

- A. Weir will be located downstream of the UV modules to maintain an average water depth of 12 inches and provide lamp submergence at all times.
- B. Maximum effluent level variance from zero to peak flow will not exceed 1.5 inches (3.8 cm).
- C. Weir will be welded water tight and include a drain.
- D. Weir shall be constructed of stainless steel.

2.09 CONTROLS AND INSTRUMENTATION

A. General:

1. The UV disinfection system shall be provided with all required electrical sub-systems and connections. Each bank shall be powered from Power Distribution Receptacles (PDR) and each lamp shall interface with the Monitoring System.
2. UV system manufacturer shall supply electrical termination points and cable, from lamps to ballast, and ballasts to PDR as well as from each bank UV sensor to the monitoring system in accordance with all relevant ANSI and NEC specifications.
3. Control panel shall interface with the SCADA system. Provide coordination with OWNER and Section 26 09 00 System Supplier. Coordination shall include submittal of data point listing as a minimum.
4. Electrical cables and connectors exposed to UV dose or installed outdoors shall be furnished with UV resistant materials.
5. Unless otherwise approved, the maximum total power consumption for disinfection allowed shall be no greater than 2,800 watts.

B. Power Distribution Receptacle (PDR):

1. A PDR shall be provided for every two UV modules. The system shall be supplied with one UV bank and four PDRs.
2. Power shall be supplied to each PDR by Division 26 and shall be 20-amp, 120-volt, single-phase, 60Hz.
3. Each PDR shall be duplex and GFCI-type.
4. Each PDR shall be mounted in an impact resistant thermoplastic junction box (splitter panel) with a Type 3R rain shield for outdoor installation.

C. UV Sensor: A submersible UV sensor shall continuously monitor the UV intensity produced in each bank of UV lamps. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps. The detection system shall be factory calibrated. Cable length shall be 15' and 0".

D. System Monitor:

1. System Monitor shall be provided for the UV bank and display operating conditions. Operating conditions shall be indicated on a three-character LED display. At a minimum, these conditions shall include:
 - a. Lamp age (hours).
 - b. UV intensity (mW/cm^2).
2. The following status signals shall be communicated from the System Monitor to the plant SCADA system. Signals shall be wired to terminal blocks within the System Monitor.
 - a. Low UV Intensity Alarm (discrete output to SCADA).
 - b. UV Intensity Output (4-20 mA output to SCADA.)
3. System Monitor enclosure shall be NEMA 4X, FRP, suitable for wall-mounting. System Monitor enclosure shall be provided with a sun shield.
4. Power to the System Monitor shall be 120-volts, single-phase, and a maximum of 5-amps.

2.10 CONTROLS

- A. All equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 26 and Section 40 70 00.

- B. Equipment manufacturer shall review electrical wiring and control diagrams prepared by the Division 26 contractor. Manufacturer shall provide written approval to CONTRACTOR with copy to ENGINEER and OWNER.

2.11 SPARE PARTS AND SAFETY EQUIPMENT

- A. Provide the following spare parts:
 1. Four UV Lamps.
 2. Four quartz sleeves.
 3. Four lamp holder seals.
 4. One operator's kit including face shield, gloves, and cleaning solution.
 5. One area warning sign.

2.12 MOVEABLE STORAGE RACKS, LIFTING FRAME, AND DAVIT CRANE

- A. Equipment manufacturer shall provide storage rack(s) adequate to store all UV modules and bulbs out of the channel. Storage rack(s) shall be mounted on wheels. Storage rack(s) shall be fabricated out of 304 stainless steel.
- B. Equipment manufacturer shall provide a lifting frame and sling that attaches to the top ends of a UV module and allows the module to be lifted vertically from the channel from a single point using a davit crane.
- C. Equipment manufacturer shall provide a davit crane. Exact installation location shall be determined by the manufacturer.

2.13 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and one day on site shall be provided for startup and training services.
- C. The UV equipment manufacturer shall furnish to OWNER, through ENGINEER, a written report certifying that the UV system has been properly installed and has achieved required guaranteed performance based on field testing results.
- D. For the life of the UV system, the UV manufacturer shall dispose of returned lamps (old and used) at no cost to OWNER upon receipt of the returned lamps at the manufacturer's headquarters.

END OF SECTION

Section 46 66 56-7

4640.003/1-2021

GEOTECHNICAL REPORT

**SUBSURFACE INVESTIGATION AND
GEOTECHNICAL RECOMMENDATIONS**

**SYCAMORE TRAILS WATER TREATMENT PLANT UPGRADES
WIND FOREST DRIVE
CLEARCREEK TWP., WARREN CO., OHIO**

Prepared for:

**WARREN COUNTY SEWER AND WATER DEPARTMENT
406 JUSTICE DRIVE
LEBANON, OHIO 45036**

Prepared by:

**ALT & WITZIG ENGINEERING, INC.
WEST CHESTER, OHIO**

JUNE 9, 2020

PROJECT NO.: 20CN0117



Alt & Witzig Engineering, Inc.

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Phone: (513) 777-9890 • www.altwitzig.com

June 9, 2020

Warren County Sewer & Water Department
406 Justice Drive
Lebanon, Ohio 45036
Attn: Ms. Kathryn Gilbert

RE: Geotechnical Exploration
Sycamore Trails WWTP Upgrades
Wind Forest Drive
Clearcreek Twp., Warren Co., Ohio
Alt & Witzig File #: 20CN0117

Dear Ms. Gilbert:

In compliance with your request, Alt & Witzig Engineering has completed an analysis on the subsurface materials for the proposed upgrades to the wastewater treatment plant at the dead end of Wind Forest Drive in Clearcreek Twp., Warren Co., Ohio. Structural plans and proposed structure elevations have not been provided at this time. The scope of this investigation included a review of geological maps of the area and related literature; a reconnaissance of the project site; subsurface exploration; field and laboratory testing; and an engineering analysis and evaluation of the encountered subsurface materials.

Field Investigations

Field investigations to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site and performing 6 soil borings. The location of the borings are shown in figure 1. The soil borings were performed with a drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples were obtained employing split-spoon sampling procedures in accordance with ASTM Procedure D-1586. The borings were performed from the existing ground surface down to termination of the borings at auger refusal in bedrock.

During the sampling procedure, Standard Penetration Tests were performed at regular intervals to obtain the Standard Penetration Test value of the soil. The Standard Penetration Test value is defined as the number of blows a 140-pound hammer, falling 30 inches, is required to advance the split-spoon sampler 1 foot into the soil. The results of the Standard Penetration Tests indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

- Visual classification in accordance with ASTM D 2488.
- Moisture content tests in accordance with ASTM D 2216.

Samples of the cohesive soil from the split-spoon-sampling device were frequently tested in unconfined compression by use of a calibrated spring testing machine. In addition, a calibrated soil penetrometer was used as an aid in determining the strength of the soil. The values of the unconfined compressive strength as determined on soil samples from the split-spoon sampling must be considered, recognizing the manner in which they were obtained since the split-spoon sampling techniques provide a representative but somewhat disturbed soil sample.

Project Description

The site is located at the eastern dead end of Wind Forest Drive in Clearwater Twp., Warren Co., Ohio. The property is currently occupied by an existing wastewater treatment plant. The upgrades will improve multiple new elements, as well as replacement of existing elements. It is understood that the plant will receive a new screening channel, new aeration tanks, 2 new circular clarifiers, a return activated sludge and waste activated sludge (RAS and WAS) pumping station, a new blower building, and a new disinfection and post-aeration structure. As a part of these improvements the primary structures to be built for these processes includes:

- Screening Structure (16' wide by 32' long by 8' deep concrete channel)
- Aeration Tanks (50' long by 26' wide by 16' deep concrete channel)
- Blower Building (15' wide by 34' long wood framed building with 4' deep footings for frost). This building will be constructed in the existing sludge drying beds which are to be removed and filled with structural fill.
- Concrete Clarifiers (26' diameter by 16' deep support by a mat foundation). The new structure will be constructed within the footprint of the existing aeration tanks that will be removed.
- Disinfection and Post-aeration Structure (8' wide by 16' long by 8' deep concrete structure). This tank structure will be supported on a mat foundation.

The purpose of the investigation is to offer subsurface information and geotechnical parameters to facilitate design and construction of the improvements.

Subsurface Investigation

Variable depths of existing fill were encountered across the site. Borings B1, B2, and B6 encountered existing fills to depths of 4 to 8 feet below the existing ground surface. The existing fills was comprised of brown and gray clay with variable amounts of sand, gravel, and organic matter. The following table provides the depth of existing fills at each boring location (borings not listed did not encountered any existing fill soils.

Boring	Depth of Existing Fills (ft)	Elevation of Bottom of Fill (ft MSL)
B1	4	751.0
B2	7	745.0
B6	8	738.0

Underlying the existing fill, borings encountered brown very stiff clay with limestone gravel and cobble to termination of the borings on gray shale and limestone bedrock. The shale was encountered between 4 and 14 feet below the existing ground surface, being shallow at the western/southwestern end of the compound. The following table provides the depth to depth at each boring location.

Boring	Depth to Shale Bedrock (ft)	Elevation of Top of Shale Bedrock (ft MSL)
B1	14	741.0
B2	10	742.0
B3	10	743.0
B4	4	745.0
B5	7*	742.0
B6	12	734.0

*Boring B5 encountered auger refusal at 7 feet and a bedrock sample was not obtained after multiple attempts. The auger refusal depth is assumed to be on the shale bedrock.

Groundwater was not encountered during drilling operations, but some groundwater seepage could be encountered at the interface between soil and bedrock. However, depending upon the time of the year and the weather conditions when the excavations are made, surface runoff can occur into shallow excavations causing the softening of the subgrade soils. Since these subsurface materials tend to loosen when exposed to free water, every effort should be made to keep the excavations dry should water be encountered. The exact location of the water table should be anticipated to fluctuate somewhat depending upon normal seasonal variations in precipitation and surface runoff. In addition, it generally requires several months of observation to estimate groundwater levels and the levels given on the enclosed boring logs are from the short observations made during our on-site observations.

Seismic Parameters

An evaluation of the seismic site class has been performed for this site. The Ohio Building Code indicates that the seismic site class is determined by averaging soil conditions within the top 100 feet with respect to the shear wave velocity. This evaluation is based on data obtained on soil to termination of the borings and our knowledge of soils in the area. Based on the field and laboratory tests performed on the encountered subsurface materials to boring termination, this site should be considered a Site Class C in accordance with the current Ohio Building Code. Depending upon final structure elevations, a Site Class B could be used. Review of final grading would be required to determine which structures can be designed with a Site Class B.

Foundation Discussion and Recommendations

At this time, structural plans and proposed elevations have not been provided for the improvements. However, based on Alt & Witzig's understanding of the proposed improvements, a shallow foundation system in form of conventional footings/mat foundation can be utilized to support structures placed on the site. Once structural plans and structural loads generated, it should be provided to Alt & Witzig to review and provide further recommendations, if any, regarding foundation design.

Conventional Footings/Mat Foundation

The various structures on the site will have variable foundation depths. A net allowable bearing pressure of 3,000 psf can be utilized to dimension conventional foundations that bear on the native clay soils. A modulus of subgrade reaction, k_{30} , of 100 pci is recommended for the mat foundations that bear on the native clays. However, based on the depth of the structural elements, multiple structures will extend to the shale bedrock. A net allowable bearing pressure of 12,000 psf can be utilized to dimension foundations that bear entirely on the shale bedrock. A modulus of subgrade reaction, k_{30} , of 400 pci is recommended for the mat foundations that bear on the shale. If portions of the structure will bear on both the shale and clay, the 3,000 psf bearing capacity (modulus of subgrade of 100 pci) should be used for design.

The modulus of subgrade reaction provided is for point load conditions. The modulus must be modified when area loads are applied. The modulus should be modified by:

- Square Foundations, $k_s = \frac{k_{30}}{B}$, where B is the footing width in ft
- Rectangular Foundations, $k_r = \frac{k_s(1+0.5\frac{B}{L})}{1.5}$, where B is the footing width and L is the footing length in ft.

Note that existing fill soils were encountered in borings B1, B2, and B6 to a depth of 4 to 8 feet (738.0 to 751.0 ft MSL). Based on the anticipated depth of foundations, the existing fills will be removed by design during foundation excavation. However, if existing fills are present in the base of the foundation after excavation of the foundation, the existing fill soils must be undercut and replaced with structural fill or lean concrete. (See figure below for the geometry of these options).

It is recommended that a permanent subsurface drainage system be installed at or near the base of all below grade walls. A continuous back drains would be sufficient to reduce the water pressure that will accumulate in the backfill used for the walls. It is important that the drainage system be protected against clogging by some form of filter. It is recommended that the materials used as backfill be clean sand and gravel containing less than 10 percent fines by weight. The equivalent fluid pressure provided is applicable during a fully drained condition.

The above-recommended bearing pressure is a "net allowable soil pressure". In utilizing this net allowable pressure for dimensioning footings, it is necessary to consider only those loads applied above the finished floor elevations. Using the above-mentioned bearing pressures, total settlements of less than 1 inch and differential settlements of less than 1/2 inch are estimated.

Construction Recommendations

Multiple below ground structural elements will be added with the proposed upgrades, with some elements being initially proposed as deep at 16 feet below the surface. The soils encountered across the project consisted of cohesive soils (brown clay) with various degrees of stiffness. The cohesive soils classify as OSHA Type B soils and temporary slopes in excavations on the order of 1:1 (H:V) should be maintained. Flattening of the slope should be performed as necessary for safety purposes. Temporary excavations in the bedrock material can be performed with near vertical side walls.

These soils are very sensitive to moisture so, all excavation slopes should be monitored for changes due to weather conditions and water seepage. Should excessive seepage of groundwater be encountered, flattening of the slopes should be performed as necessary for safety purposes.

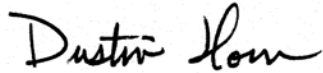
Backfill of all backfill zones utility excavations and in structural areas should be continually monitored by Alt & Witzig to verify that proper lift thickness, moisture condition, and compactive effort are maintained.

Shale bedrock was encountered between 4 and 14 feet below the surface of the site, sloping down from southwest to east/northeast. Given the most of the water treatment plant elements are below ground, it is anticipated that bedrock excavation will be required in order to establish foundation elevation of the WWTP structures. It is recommended that the equipment utilized to perform the excavations on site be of sufficient size and power to readily remove the shale bedrock. Generally, a minimum 100,000 lb excavation equipped with a ripper blade and/or hoe ram (breaker) will be required to remove the bedrock in the area.

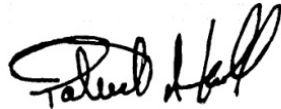
Sycamore Trails WWTP Upgrades
Alt & Witzig File No.: 20CN0117
June 9, 2020
Page 8

As previously mentioned, structural plans, loads, and proposed elevations should be provided to Alt & Witzig to provide further recommendations, if any regarding foundation design. If we can give further service in these matters, please contact us at your convenience.

Respectfully Submitted,
ALT & WITZIG ENGINEERING, INC.



Dustin M. Horn
Project Engineer



Patrick A. Knoll, P.E.
Principal Engineer



APPENDIX

Recommended Specifications for Compacted Fills and Backfills
Boring Location Plan
Boring Logs
General Notes

RECOMMENDED SPECIFICATIONS FOR COMPACTED FILLS AND BACKFILLS

All fill shall be formed from material free of vegetable matter, rubbish, large rock, and other deleterious material. Prior to placement of fill, a sample of the proposed fill material should be submitted to the soils engineer for his approval. The fill material should be placed in layers not to exceed eight (8) inches in loose thickness and should be sprinkled with water as required to secure specified compactions. Each layer should be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Material containing an excess of water so the specified compaction limits cannot be attained should be spread and dried to a moisture content that will permit proper compaction. All fill should be compacted to the specified percent of the maximum density obtained in accordance with ASTM density Test D1557 (95 percent of maximum dry density). Should the results of the in-place density tests indicate that the specified compaction limits are not obtained, the areas represented by such tests should be reworked and retested as required until the specified limits are reached.

compressive strength as determined on soil samples from the split-spoon sampling must be considered, recognizing the manner in which they were obtained since the split-spoon sampling techniques provide a representative but somewhat disturbed soil sample.

Project Description

The site is located at the eastern dead end of Wind Forest Drive in Clearwater Twp., Warren Co., Ohio. The property is currently occupied by an existing wastewater treatment plant. The upgrades will include the construction of an electrical building surrounded by a retaining wall on the northwestern portion of the facility and excavation of a pond at the southernmost portion of the site. The purpose of the investigation is to offer subsurface information and geotechnical parameters to facilitate design and construction of the improvements.

Subsurface Investigation

Consistent soil conditions were encountered along the wall alignment. Borings W1 and W2 encountered approximately 3 feet of soft to medium stiff clay underlain by stiff clay with limestone cobble to a depth of 13 feet below the existing ground surface. At 13 feet both borings encountered gray weathered shale with limestone seams. The following table provides the elevation of shale at each boring location:

Boring	Depth of Shale During Drilling (ft)	Elevation to of Top of Shale (ft MSL)
W1	13.0	948
W2	13.0	946

Boring P1 was performed in the footprint of the proposed pond at the southern end of the site. The boring encountered 3 feet of medium stiff clay underlain by gray weathered shale with limestone seams.

Groundwater was not encountered during drilling operations, but some groundwater seepage could be encountered at the interface between soil and bedrock. The exact location of the water table should be anticipated to fluctuate somewhat depending upon normal seasonal variations in precipitation and surface runoff. In addition, it generally requires several months of observation to estimate groundwater levels and the levels given on the enclosed boring logs are from the short observations made during on-site observations.

Foundation Discussion and Recommendations

A new electrical building will be constructed near boring W1 and W2. For design of the electrical building foundations, the following parameters can be utilized.

	Footing Type	
	Continuous Footings	Spread Footings
Net Allowable Bearing Pressure*	3,000 psf*	3,000 psf*
Minimum Footing Depth	30 inches	30 inches
Minimum Footing Size**	12 inches wide**	24 inches square**
Estimated Maximum Total Settlement	½ inch	½ inch
Estimated Maximum Differential Settlement	½ inch	½ inch
* In utilizing a net allowable bearing pressure, it is only necessary to account for structural loads applied above finished floor elevation. ** Minimum footing sizes should be in compliance with actual building loads and conform to local building codes.		

All footings excavations should be inspected by a representative of Alt & Witzig Engineering to ensure suitable soils exist in the base of all footings. At the time of the inspection, a visual examination, hand penetrometer, and/or house penetrometer tests can be performed on the foundation soils. Soils found to be unsuitable for bearing should be undercut to a more stable material. These excavations that are undercut should be filled back to bottom of footing elevation with lean concrete. Lean concrete is a low strength concrete (1,000 to 1,500 psi 28 day compressive strength) that transfer structural loads directly down onto the soils on which it was poured.

Retaining Wall Discussions and Recommendations

Bottom-Up Wall Construction

A retaining wall will be constructed surrounding 3 sides of the new electrical building. The retaining wall will have a maximum exposed height of 10 feet. The exact wall type has not been determined at the time of this report; however, the face of the wall will sit approximately 15 feet from the property line. Based on the encountered conditions, it is recommended that either a concrete cantilever wall or gravity block wall be utilized. It is anticipated that the excavation and installation of these wall types can be performed within the property limits.

The following table can be utilized for the design of a concrete cantilever wall or a gravity block wall behind the electrical building:

Foundation Type	Conventional Foundations
Net Allowable Bearing Pressure	3,000
Coefficient of Sliding Friction	0.40
Passive Pressure	300D psf/ft (where D is depth of the wall toe in ft)
Active Earth Pressure	40H psf/ft (where H is height of wall in ft)

Both the passive and active earth pressures would increase linearly from 0 psf at ground surface to a maximum at the base of the wall. In addition, passive earth pressures should be ignored in the upper 24 inches of the soil profile.

It is recommended that a permanent subsurface drainage system be installed at or near the base of all below grade walls. A continuous back drain would be sufficient to reduce the water pressure that will accumulate in the backfill used for the walls. It is important that the drainage system be protected against clogging by some form of filter. It is recommended that the materials used as backfill be clean sand and gravel containing less than 10 percent fines by weight. The equivalent fluid pressure provided is applicable during a fully drained condition.

Top-Down Wall Construction

If a bottom-up wall construction is found to be unfeasible, a top-down construction technique can be utilized. Generally, a top-down wall technique can be installed with little to no excavation required behind the wall. Given the shallow depth of rock once the wall is cut, it is recommended that a driven technique be avoided. Instead, a pier wall with steel beams and wood/concrete lagging is recommended. The beam locations would be predrilled for installation of the beams. An active earth pressure of 40 psf/ft should be applied to the wall. The following parameters can be used for pier wall design:

Soil Description	Total Density (pcf)	Cohesion (c') (psf)	Unconfined Compressive Strength (q _u) (psi)	Pile p-y Model	Recommended Average SPT (N-value)	Lateral Modulus of Subgrade Reaction	Strain Factor, e ₅₀
Brown Clay with Cobble	125	3,000	N/A	Stiff Clay w/ Free Water	30	500 pci	0.005
Gray Shale with Limestone Seams	145	N/A	500	Weak Rock	N/A	N/A	N/A

Consideration can also be given to the use of a soil nail wall. It is anticipated that soil nails of approximately 10 feet would be required behind the wall. Soil nail walls are designed with a slope stability analysis. The following parameters can be used for soil nail design:

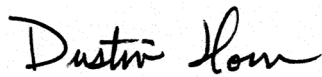
Soil Description	Total Density (pcf)	Effective Cohesion (c') (psf)	Effective Angle of Internal Friction	Ultimate Grout to Soil Bond Strength (psi)
Brown Clay with Cobble	125	100	26	12

Pond Recommendations

A pond is proposed at the southernmost end of the site. Shale bedrock was encountered at 3 feet below the existing ground surface at the pond location and bedrock excavation will be required during excavation of the pond. The shale bedrock is expected to be shallower to the west and deeper to the east. It is recommended that the equipment utilized to perform the excavations on site be of sufficient size and power to readily remove the shale bedrock. Generally, a minimum 100,000 lb excavation equipped with a ripper blade and/or hoe ram (breaker) will be required to remove the bedrock in the area.

As previously mentioned, structural plans, loads, and proposed elevations should be provided to Alt & Witzig to provide further recommendations, if any regarding foundation design. If we can give further service in these matters, please contact us at your convenience.

Respectfully Submitted,
ALT & WITZIG ENGINEERING, INC.



Dustin M. Horn
Project Engineer



Patrick A. Knoll, P.E.
Principal Engineer



APPENDIX

Recommended Specifications for Compacted Fills and Backfills
Boring Location Plan
Boring Logs
General Notes

RECOMMENDED SPECIFICATIONS FOR COMPACTED FILLS AND BACKFILLS

All fill shall be formed from material free of vegetable matter, rubbish, large rock, and other deleterious material. Prior to placement of fill, a sample of the proposed fill material should be submitted to the soils engineer for his approval. The fill material should be placed in layers not to exceed eight (8) inches in loose thickness and should be sprinkled with water as required to secure specified compactions. Each layer should be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Material containing an excess of water so the specified compaction limits cannot be attained should be spread and dried to a moisture content that will permit proper compaction. All fill should be compacted to the specified percent of the maximum density obtained in accordance with ASTM density Test D1557 (95 percent of maximum dry density). Should the results of the in-place density tests indicate that the specified compaction limits are not obtained, the areas represented by such tests should be reworked and retested as required until the specified limits are reached.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

- N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.
- Qu: Unconfined compressive strength, TSF
- Qp: Penetrometer value, unconfined compressive strength, TSF
- Mc: Water content, %
- LL: Liquid limit, %
- PL: Plastic limit, %
- Dd: Natural dry density, PCF
- : Apparent groundwater level at time noted after completion

DRILLING AND SAMPLING SYMBOLS

- SS: Split-spoon - 1 3/8" I.D., 2" O.D., except where noted
- ST: Shelby tube - 3" O.D., except where noted
- AU: Auger sample
- DB: Diamond bit
- CB: Carbide bit
- WS: Washed sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

<u>TERM (NON-COHESIVE SOILS)</u>	<u>BLOWS PER FOOT</u>
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

<u>TERM (COHESIVE SOILS)</u>	<u>Qu (TSF)</u>
Very soft	0 - 0.25
Soft	0.25 - 0.50
Medium	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.(+)	Coarse Sand	5 mm-0.6 mm	Silt	0.075 mm - 0.005 mm
Cobbles	8 in. - 3 in.	Medium Sand	0.6mm-0.2 mm	Clay	0.005mm(-)
Gravel	3 in. - 5 mm	Fine Sand	0.2mm-0.075 mm		

For more location information
please visit www.strand.com

Office Locations

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Phoenix, Arizona | 602.437.3733

*Corporate Headquarters





BOARD OF COUNTY COMMISSIONERS
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Telephone (513) 695-1250

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TOM GROSSMANN
SHANNON JONES
DAVID G. YOUNG

INVITATION TO BIDDERS

Sealed bids will be received by the Clerk of the County Commissioners, Warren County, Ohio, 406 Justice Drive, Lebanon, Ohio 45036, until 11:00 AM, Thursday April 14, 2022, at the Office of the Warren County Commissioners, and then at said time bids will be opened and read aloud for the Sycamore Trails Wastewater Treatment Plant Upgrades Project.

Bid documents including terms, general conditions, supplemental conditions, and specifications are available online at the Warren County's Website at <https://www.co.warren.oh.us/commissioners/Bids/Default.aspx>. Questions regarding the technical specifications should be directed to Kathryn Gilbert at the Warren County Water and Sewer Department, (513) 695-1645. Contact the Warren County Commissioners Office at (513) 695-1250 should you need assistance in accessing the bidding information on the County website.

The project generally consists of the installation of new mechanical screening, aeration tanks and blowers, secondary clarification, UV disinfection and post-aeration, liquid sludge storage and blower, two pumping stations, electrical building, backup generator, storage shed and corresponding electrical, control, piping, and site upgrades to be installed at the Sycamore Trails Wastewater Treatment Plant. The estimated contract value is \$5,933,000.00.

The Board of Warren County Commissioners reserves the right to accept the lowest and best bid, to reject all bids, and to waive any irregularities in bids.

By order of the Board of County Commissioners, Warren County, Ohio.

A bid guaranty, as required by Ohio Revised Code, Section 153.54, shall accompany each proposal submitted, as follows:

1. A Certified check, cashier's check, or letter of credit equal to ten (10) percent of the bid. A letter of credit may only be revocable by the Owner. Upon entering into a contract with the Owner, the contractor must file a performance bond for the amount of the contract, and the bid guaranty will then be returned to the successful and unsuccessful bidders upon contract execution.

OR

2. A form of bid guaranty bond (attached) for the full amount of the bid. Such bond is retained for the successful bidder but returned to unsuccessful bidders after the contract is executed.

Warren County reserves the right to reject any or all bids submitted, to waive any irregularities in bids, and enter into a contract with the Bidder who in Warren County's consideration offered the lowest and best bid. By order of the Board of County Commissioner, County of Warren, State of Ohio.


Tina Osborne, Clerk