CONTRACT DOCUMENTS

FOR

CITY OF WOOSTER
REBID - BIOSOLIDS UPGRADE PROJECT

IN

WAYNE COUNTY

OHIO

APRIL 2024

CONTRACT NO. GC 24-01

Project No. 122022001

Prepared by:

RETTEW Associates, Inc.
3475 Forest Lake Drive, Suite 100
Uniontown, OH 44685
800-738-8395

CITY OF WOOSTER
REBID - BIOSOLIDS UPGRADE PROJECT
CONTRACT NO. – GC 24-01

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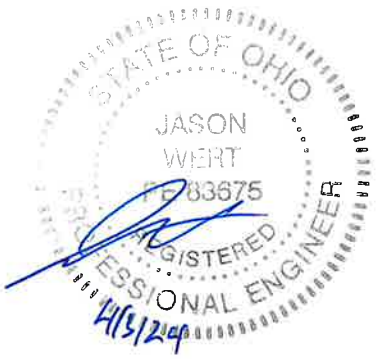

Wooster
EST 1808 OHIO

City of Wooster

Rebid - Biosolids Upgrade Project

Contract No. – GC 24-01

April 2024

RETTEW Project No.
122022001

RETTEW

CITY OF WOOSTER

538 N MARKET STREET

WOOSTER, OH 44691

CONTRACT DOCUMENTS

FOR

WRRF DIGESTER IMPROVEMENTS

Bids due 12:00 noon, Friday, April 26, 2024

Please provide the following information to facilitate the Bid Opening and processing of purchase orders and other communications:

Company: _____

Contact Person: _____

Address: _____

City: _____ County: _____ State:_____

Zip Code: _____

Federal Identification or Social Security number: _____

Telephone number of business office: _____

Telephone number of person submitting the bid: _____

E-Mail: _____

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION A

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CITY OF WOOSTER, OHIO
BIOSOLIDS UPGRADE PROJECT

INDEX TO CONTRACT DOCUMENTS

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION B

LEGAL NOTICE

LEGAL NOTICE

Sealed bids will be received by the City Engineer on behalf of the Director of Administration, City of Wooster, State of Ohio, at the office of said City Engineer, 538 N. Market Street, Wooster, Ohio, 44691 until twelve o'clock noon, Friday, April 26, 2024, for the **REBID - BIOSOLIDS UPGRADE PROJECT** in accordance with the specifications on file in said office.

Project Description:

1. Replacement of the existing mechanical anaerobic digester mixing system with jet mixing.
2. Replacement of the existing anaerobic digester gas holding covers.
3. Modifications to existing biogas piping to improve overall system safety and integrity.
4. Replacement of waste biogas flare.
5. Relocation of the Water Treatment Plant medium voltage transformer.
6. Replacement of existing gravity belt thickener with new gravity belt thickener.
7. Installation of yard piping, instrumentation, and related appurtenances.

Project Cost: The Engineer's estimated construction cost for this project is $4-4.5MM.

Project Completion Date: June 27, 2025.

Each bid must contain the full name of every person or company interested in the same and be accompanied by a bidding bond or a certified check in the amount of 10% of the bid price as a guaranty that if the bid is accepted, a contract will be entered into and its performance secured OR provide a contract bond for 100% of the bid amount.

Copies of the contract documents are on file in the office of the City Engineer, City of Wooster, Ohio and are available for inspection by prospective bidders in the office or on the city's bidding information webpage https://www.woosteroh.com/engineering/bidding-information. Bidders must register for the plans through the city's ViewPoint website. Bidders must be registered for their bids to be considered. Bid book and plans will be sent electronically.

A voluntary pre-bid meeting will be held virtually on the week of April 15th. Final date and time forthcoming.

This contract is subject to the following: Minimum wage rates as determined by United States Secretary of Labor under Subchapter IV of Chapter 31 of Title 40 USC shall apply to this Project. (Davis-Bacon Wage Rates); the Federal Occupational Safety and Health Act of 1970 (OSHA) conditions; the Ohio One Call Act.

Additionally, the Contractor is required to meet the provisions of the Inflation Reduction Act that modifies the Internal Revenue Code, Section 45(b)(8)(A)(i), for the provision of qualified Apprenticeship to complete construction, alteration, or repair work. The minimum percentage of Apprenticeship Labor Hour Requirements shall be 12.5% as defined in Section 45(b)(8)(A)(ii), Section 45(b)(8)(C), and Section 45(b)(8)(D).

All contractors and subcontractors involved with the project will, to the extent practicable use Ohio Products, materials, services, and labor in the implementation of their project. Additionally, contractor compliance with the equal employment opportunity requirements of Ohio Administrative Code Chapter 123, the Governor's Executive

Order of 1972, and Governor's Executive Order 84-9 shall be required.

Bidders are required to use the forms which will be furnished on application.

Contact the City Engineer at 330-263-5251 for all questions and requests for additional information.

By order of the Director of Administration.

_____

Joel Montgomery, P.E.
Director of Administration

Advertise: Friday, April 5, 2024

2nd Advertisement: Friday, April 12, 2024

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION C

INSTRUCTIONS FOR BIDDERS

INSTRUCTIONS TO BIDDERS

1. SUBMISSION OF BIDS

Sealed bids for BIOSOLIDS UPGRADE PROJECT will be received by the Director of Administration in the Municipal Building, 538 N Market Street, Wooster, Ohio 44691, until noon, on the date specified in the Legal Notice, at which time they will be publicly opened and read aloud.

In order to receive consideration, bids shall be submitted in the following manner:

a) Bid proposals must be received prior to the time of bid opening. No proposals received after said time of bid opening will be considered, and the proposals will be returned unopened to any bidders failing to submit bids prior to the time of bid opening.
b) Bid proposals shall be submitted in a sealed envelope marked "BID FOR BIOSOLIDS UPGRADE PROJECT." If forwarded by mail, the envelope shall be sent inside another envelope also marked "BID FOR BIOSOLID UPGRADE PROJECT" and addressed to the Director of Administration.
c) All bids shall be signed and submitted on the blanks, which are found in the bidding documents. All blanks shall be completed in full. A bid of zero dollars or $0.00 shall be filled in with either zero, 0 or $0.00.
d) All bid proposals shall be typewritten or filled in with pen and ink, and shall be signed with pen and ink. The proposal must be signed with the firm name and by an officer or employee having the authority to bind the company or firm by his/her signature.
e) Bidder must be a plan holder of record and obtained plans from the City.

2. QUESTIONS

Questions pertaining to the project shall be submitted no later than five (5) working days prior to the date specified in the legal notice for the bid opening. This time is provided to adequately prepare a response and not influence the bid date.

3. BIDDING DOCUMENTS

Complete sets of Bidding Documents must be used in preparing Bids; the City assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Bid Documents thoroughly, (b) consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (c) study and carefully correlate Bidder's observations with the Bid Documents, (d) notify the Director of Administration of all conflicts, errors or discrepancies in the Bid Documents, and (e) if applicable, visit the site of the work to familiarize itself with the characteristics of

the work site.

Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations and investigations, and obtain any additional information and data which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

The submission of Bid will constitute an irreversible representation by Bidder that Bidder has complied with every requirement of the Contract Documents, and without exception the Bid is premised upon performing and furnishing all of the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work. All bids shall be valid for sixty (60) days and City shall have up to sixty (60) days to issue a Notice of Award to the successful bidder.

4. BID GUARANTY/PERFORMANCE BOND

Each bid shall be accompanied by a Bid Guaranty in the form of a certified check or a bid bond payable to the City of Wooster, in a sum not less than Ten Percent (10%) of the total amount bid, not including extra cost options, or a Contract Bond for the total amount of the bid (100%). Certified checks or bid bonds will be returned to unsuccessful bidders within thirty days of bid opening.

The successful bidder shall furnish a performance and payment bond in an amount equal to the contract amount as security for the faithful performance and payment of all contractors' obligations under the Contract Documents.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) must be authorized to issue surety bonds in Ohio by the Superintendent of the Ohio Department of Insurance and properly licensed by the Ohio Department of Insurance to do business in the State of Ohio.

5. PRICES TO INCLUDE

The price bid for all items of work shall include all labor, materials, tools, equipment, etc., necessary to furnish and install in place, complete and in operating condition the items listed, shown and/or specified.

6. VARIATION FROM SPECIFICATIONS

Any items which the bidder wishes the City to consider in evaluation of these bids shall be included in the bid package. Items submitted separately will not be considered by the City.

Items included with the bid and representations made therein shall be considered to be binding upon the bidder.

7. TAXES

The City of Wooster is exempt from any sales or use taxes imposed by the State of Ohio and/or the United States Government. All bids shall exclude sales or use taxes on the Project. Exemption certificates will be certified upon request by any prospective bidder.

8. DISCLOSURE OF DELINQUENT PERSONAL PROPERTY TAXES

This contract is subject to the requirements of Section 5719.042 of the Ohio Revised Code. The successful bidder, after being notified of the award of the contract and prior to the time the contract is entered into, shall submit a statement to the City Auditor of the City of Wooster, Ohio, affirmed under oath, disclosing whether or not the bidder, at the time the bid was submitted, was charged with any delinquent personal property taxes, and a copy of the statement shall be incorporated into the contract.

9. ACCEPTANCE OF BIDS

The City of Wooster, Ohio reserves the right to reject any and all bids; to waive minor irregularities in the bid and to award the contract or contracts to the lowest and best bidder which the City deems will best serve the City.

The City reserves the right to reject the Bid of any Bidder if City believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by City or the bid is unbalanced as defined by the Ohio Department of Transportation Construction and Materials Specifications, current edition.

Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

In evaluating Bids, City will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid form or prior to the Notice of Award.

City may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. City also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

City may conduct such investigations as City deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to City's satisfaction within the prescribed time.

If the Contract is to be awarded, it will be awarded to the lowest and best Bidder whose evaluation by City indicates to City that the award will be in the best interests of the Project.

If the Contract is to be awarded, City will give the Successful Bidder a Notice of Award within sixty days after the day of the Bid opening.

10. QUALIFICATIONS OF BIDDERS

To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within five days of City's request written evidence, such as financial data, previous experience, present commitments and other such data as may be called for below (or in the Supplementary Instructions). Each Bid must contain evidence of Bidder's qualification to do business in the State of Ohio or covenant to obtain such qualification prior to award of the Contract.

In determining the award of Contract, consideration will be given to:

a) The lowest and best bid.
b) The Bidder's record of experience in projects of this type.

No bid will be accepted from, nor Contract awarded to, anyone who is in arrears to the City upon Debt or Contract, or has defaulted on prior work for the City or otherwise upon any obligation to the City, or whose work on prior projects has proven unsatisfactory or dilatory.

The City will declare a Bid non-responsive and ineligible for award when any of the following occur:

A. The Bidder lacks sufficient prequalification work types or dollars to be eligible for award.
B. The Bidder fails to furnish the required Proposal Guaranty in the proper form and amount.
C. The Bid contains unauthorized alterations or omissions.
D. The Bid contains conditions or qualifications not provided for in the Bid Documents.
E. A single entity, under the same name or different names, or affiliated entities submits more than one Bid for the same project.
F. The Bidder fails to submit a unit price for each contract item listed, except for lump sum items where the Bidder may show a price in the “Bid Amount” column for that item.
G. The Bidder fails to submit a lump sum price where required.
H. The Bidder is debarred from submitting Bids.
I. The Bidder has defaulted, has had a Contract terminated for cause by the Department, has either agreed not to Bid or has had debarment proceedings initiated against the Bidder’s company and/or its key personnel.
J. The Bidder submits its Bid or Proposal Guaranty on forms other than those provided by the

Department.

K. The Bidder submits a Materially Unbalanced Bid.
L. The Bidder fails to acknowledge addenda.
M. The City finds evidence of collusion.
N. Any other omission, error, or act that, in the judgment of the Department, renders the Bidder's bid non-responsive.

11. WITHDRAWAL OF BID

Any bid may be withdrawn prior to the scheduled time of the bid opening, but only by submitting a request to withdraw the bid in writing and signed by the individual submitting the bid. No bidder may withdraw a bid for a period of sixty (60) days from the date of bid opening.

12. CONFLICT OF INTEREST BY THE CITY

No elected official, staff member, or employee of the City shall become directly or indirectly interested personally in any bid submitted, the contract awarded or in any part thereof.

13. REQUIREMENTS OF THE SUCCESSFUL BIDDER

a) Bidder may be required to attend a pre-award conference to explain any variations from the Specifications or conditions herein.
b) Demonstration: The successful bidders may be called upon to demonstrate to the City it ability to perform under the contract.
c) Notice of Award and Agreement: The successful bidder(s) shall be required to acknowledge the Notice of Award and to execute the Agreement on forms included herein, within ten (10) calendar days from the date of the Notice of Award.

14. SUBCONTRACTS

Bidders who proposed subcontracts must provide the following information to the City for each Subcontractor:

a) The company name of each subcontractor, its address and scope of work to be performed.
b) Delinquent Personal Property Tax Affidavit, and Qualifications Statements.
c) A list of references who may be contacted regarding ability to perform projects of a similar nature.

The City reserves the right to review the information submitted and must approve in writing all subcontractors.

15. "OR EQUAL"

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-

equal" items.

Application for such acceptance of “or equal” items will not be considered by City until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by City are set forth in the General Conditions.

Whenever a material, article, or piece of equipment is identified on the drawings or specifications by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalogue number, and if, in the opinion of the City, such material, article, or piece of equipment is of equal substance and function to that specified, the City may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time.

16. SIGNING OF AGREEMENT

When City gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within the time stipulated in the "Notice of Award" thereafter Contractor shall sign and deliver the required number of counterparts of the Agreement and attached documents to City with the required Bonds. Within twenty days thereafter City shall deliver one fully signed counterpart to Contractor.

17. PATENTS

The Contractor shall pay all applicable royalties and license fees. It shall defend all suits or claims for infringement of any patent rights and save the City harmless from loss on account thereof, except that the City shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified; however, if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, it shall be responsible for such loss unless it promptly gives such information to the City.

18. FEDERAL REQUIREMENTS

Minimum wage rates as determined by United States Secretary of Labor under Subchapter IV of Chapter 31 of Title 40 USC shall apply to this Project (Davis-Bacon Wage Rates). It is the responsibility of the CONTRACTOR, before Bid Opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed Work under this Contract

Additionally, the CONTRACTOR is required to meet the provisions of the Inflation Reduction Act that modifies the Internal Revenue Code, Section 45(b)(8)(A)(i), for the provision of qualified Apprenticeship to complete construction, alteration, or repair work. The minimum percentage of Apprenticeship Labor Hour Requirements shall be 12.5% as defined in Section 45(b)(8)(A)(ii), Section 45(b)(8)(C), and Section 45(b)(8)(D).

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION D

DAVIS BACON WAGE RATE SCHEDULES

"General Decision Number: OH20240001 03/08/2024

Superseded General Decision Number: OH20230001

State: Ohio

Construction Types: Heavy and Highway

Counties: Ohio Statewide.

Heavy and Highway Construction Projects

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2024
1	01/26/2024
2	03/08/2024

BROH0001-001 06/01/2022

DEFIANCE, FULTON (Excluding Fulton, Amboy & Swan Creek Townships), HENRY (Excluding Monroe, Bartlow, Liberty, Washington, Richfield, Marion, Damascus & Townships & that part of Harrison Township outside corporate limits of city of Napoleon), PAULDING, PUTNAM and WILLIAMS COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0001-004 06/01/2022

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 31.40	18.55

BROH0003-002 06/01/2022

FULTON (Townships of Amboy, Swan Creek & Fulton), HENRY (Townships of Washington, Damascus, Richfield, Bartlow, Liberty, Harrison, Monroe, & Marion), LUCAS and WOOD (Townships of Perrysburg, Ross, Lake, Troy, Freedom, Montgomery, Webster, Center, Portage, Middleton, Plain, Liberty, Henry, Washington, Weston, Milton, Jackson & Grand Rapids) COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0005-003 06/01/2020

CUYAHOGA, LORAIN & MEDINA (Hinckley, Granger, Brunswick, Liverpool, Montville, York, Homer, Harrisville, Chatham, Litchfield & Spencer Townships and the city of Medina)

	Rates	Fringes
BRICKLAYER		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	$ 36.64	17.13
SANDBLASTERS	$ 36.39	17.13
SEWER BRICKLAYERS & STACK BUILDERS	$ 36.64	17.13
SWING SCAFFOLDS	$ 37.14	17.13

BROH0006-005 06/01/2022

CARROLL, COLUMBIANA (Knox, Butler, West & Hanover Townships), STARK & TUSCARAWAS

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0007-002 06/01/2022

LAWRENCE

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0007-005 06/01/2022

PORTAGE & SUMMIT

	Rates	Fringes
BRICKLAYER	$ 31.40	18.55

BROH0007-010 06/01/2017

PORTAGE & SUMMIT

	Rates	Fringes
MASON - STONE	$ 28.65	14.55

BROH0008-001 06/01/2022

COLUMBIANA (Salem, Perry, Fairfield, Center, Elk Run, Middleton, & Unity Townships and the city of New Waterford), MAHONING & TRUMBULL

	Rates	Fringes
BRICKLAYER	$ 31.40	18.55

BROH0009-002 06/01/2022

BELMONT & MONROE COUNTIES and the Townships of Warren & Mt. Pleasant and the Village of Dillonvale in JEFFERSON COUNTY

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55
Refractory	$ 31.45	19.01

BROH0010-002 06/01/2022

COLUMBIANA (St. Clair, Madison, Wayne, Franklin, Washington, Yellow Creek & Liverpool Townships) & JEFFERSON (Brush Creek & Saline Townships)

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0014-002 06/01/2022

HARRISON & JEFFERSON (Except Mt. Pleasant, Warren, Brush Creek, Saline & Salineville Townships & the Village of Dillonvale)

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0016-002 06/01/2022

ASHTABULA, GEAUGA, and LAKE COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0018-002 06/01/2022

BROWN, BUTLER, CLERMONT, HAMILTON, PREBLE (Gasper, Dixon, Israel, Lanier, Somers & Gratis Townships) & WARREN COUNTIES:

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0022-004 06/01/2022

CHAMPAIGN, CLARK, CLINTON, DARKE, GREENE, HIGHLAND, LOGAN, MIAMI, MONTGOMERY, PREBLE (Jackson, Monroe, Harrison, Twin, Jefferson & Washington Townships) and SHELBY COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0032-001 06/01/2022

GALLIA & MEIGS

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0035-002 06/01/2022

ALLEN, AUGLAIZE, MERCER and VAN WERT COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0039-002 06/01/2022

ADAMS & SCIOTO

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

BROH0040-003 06/01/2022

ASHLAND, CRAWFORD, HARDIN, HOLMES, MARION, MORROW, RICHLAND, WAYNE and WYANDOT (Except Crawford, Ridge, Richland & Tymochtee Townships) COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 32.49	23.43

FOOTNOTE: Layout Man and Sawman rate: $1.00 per hour above journeyman rate.

  Free standing stack work ground level to top of stack;
  Sandblasting and laying of carbon masonry material in swing
  stage and/or scaffold; Ramming and spading of plastics and
  gunniting: $1.50 per hour above journeyman rate.
""Hot"" work: $2.50 above journeyman rate.

BROH0044-002 06/01/2022

	Rates	Fringes
Bricklayer, Stonemason COSHOCTON, FAIRFIELD, GUERNSEY, HOCKING, KNOX, KICKING, MORGAN, MUSKINGUM, NOBLE (Beaver, Buffalo, Seneca & Wayne Townships) & PERRY COUNTIES:	$ 31.40	18.55

BROH0045-002 06/01/2021

FAYETTE, JACKSON, PIKE, ROSS and VINTON COUNTIES

	Rates	Fringes
Bricklayer, Stonemason	$ 30.40	17.66

BROH0046-002 06/01/2022

ERIE, HANCOCK, HURON, OTTAWA, SANDUSKY, SENECA, WOOD (Perry & Bloom Townships) and WYANDOT (Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES & the Islands of Lake Erie north of Sandusky

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

  FOOTNOTE: Layout Man and Sawman rate: $1.00 per hour above
  journeyman rate.
  Free standing stack work ground level to top of stack;
  Sandblasting and laying of carbon masonry material in swing
  stage and/or scaffold; Ramming and spading of plastics and
  gunniting: $1.50 per hour above journeyman rate.
""Hot"" work: $2.50 above journeyman rate.

BROH0052-001 06/01/2022

ATHENS COUNTY

	Rates	Fringes
Bricklayer, Stonemason	$ 31.40	18.55

BROH0052-003 06/01/2022

NOBLE (Brookfield, Noble, Center, Sharon, Olive, Enoch, Stock, Jackson, Jefferson & Elk Townships) and WASHINGTON COUNTIES

	Rates	Fringes

Bricklayer, Stonemason.....$ 31.40 18.55

BROH0055-003 06/01/2022

DELAWARE, FRANKLIN, MADISON, PICKAWAY and UNION COUNTIES

	Rates	Fringes
Bricklayer, Stonemason.....	$ 31.40	18.55

CARP0003-004 05/01/2017

MAHONING & TRUMBULL

	Rates	Fringes
CARPENTER.....	$ 26.20	17.42

CARP0069-003 05/01/2017

CARROLL, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
CARPENTER.....	$ 25.98	15.98

CARP0069-006 05/01/2017

COSHOCTON, HOLMES, KNOX & MORROW

	Rates	Fringes
CARPENTER.....	$ 24.04	15.29

CARP0171-002 05/01/2019

BELMONT, COLUMBIANA, HARRISON, JEFFERSON & MONROE

	Rates	Fringes
CARPENTER.....	$ 27.37	20.02

CARP0200-002 05/01/2023

ADAMS, ATHENS, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GUERNSEY, HIGHLAND, HOCKING, JACKSON, LAWRENCE, LICKING, MADISON, MARION, MEIGS, MORGAN, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, ROSS, SCIOTO, UNION, VINTON and WASHINGTON COUNTIES

	Rates	Fringes
CARPENTER.....	$ 32.42	21.42
Diver.....	$ 39.41	10.40
PILEDRIVERMAN.....	$ 32.42	21.42

CARP0248-005 07/01/2008

LUCAS & WOOD

	Rates	Fringes
CARPENTER.....	$ 27.27	14.58

CARP0248-008 07/01/2008

	Rates	Fringes
CARPENTER DEFIANCE, FULTON, HANCOCK, HENRY, PAULDING & WILLIAMS COUNTIES	$ 23.71	13.28

CARP0254-002 05/01/2017

ASHTABULA, CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
CARPENTER	$ 32.40	16.97

CARP0372-002 05/01/2023

ALLEN, AUGLAIZE, HARDIN, MERCER, PUTNAM & VAN WERT

	Rates	Fringes
CARPENTER	$ 28.85	24.59

CARP0639-003 05/01/2017

MEDINA, PORTAGE & SUMMIT

	Rates	Fringes
CARPENTER	$ 30.42	16.99

CARP0735-002 05/01/2023

ASHLAND, ERIE, HURON, LORAIN & RICHLAND

	Rates	Fringes
CARPENTER	$ 31.62	21.63

CARP1311-001 05/01/2017

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

	Rates	Fringes
Carpenter & Piledrivermen	$ 29.34	15.95
Diver	$ 40.58	9.69

CARP1393-002 07/01/2008

CRAWFORD, DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
Piledrivermen & Diver's Tender	$ 27.30	16.05

DIVERS - $250.00 per day

CARP1393-003 07/01/2008

ALLEN, AUGLAIZE, HARDIN, MERCER, PUTNAM, VAN WERT & WYANDOT

	Rates	Fringes
Piledrivermen & Diver's Tender	$ 25.15	15.92

DIVERS - $250.00 per day

CARP1871-006 05/01/2017

BELMONT, HARRISON, & MONROE

	Rates	Fringes
Diver, Wet	$ 48.11	17.33
Piledrivermen; Diver, Dry	$ 32.07	17.33

CARP1871-008 05/01/2017

ASHLAND, ASHTABULA, CUYAHOGA, ERIE, GEAUGA, HURON, LAKE,
LORAIN, MEDINA, PORTAGE, RICHLAND & SUMMIT

	Rates	Fringes
Diver, Wet	$ 45.80	18.84
Piledrivermen; Diver, Dry	$ 30.53	18.84

CARP1871-014 05/01/2017

CARROLL, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
Diver, Wet	$ 38.34	16.95
Piledrivermen; Diver, Dry	$ 25.56	16.95

CARP1871-015 05/01/2017

COSHOCTON, HOLMES, KNOX & MORROW

	Rates	Fringes
Diver, Wet	$ 37.34	16.07
Piledrivermen; Diver, Dry	$ 24.89	16.07

CARP1871-017 05/01/2017

MAHONING & TRUMBULL

	Rates	Fringes
Diver, Wet	$ 40.65	17.62
Piledrivermen; Diver, Dry	$ 27.10	17.62

CARP2235-012 01/01/2014

COLUMBIANA & JEFFERSON

	Rates	Fringes
PILEDRIVERMAN	$ 31.74	16.41

CARP2239-001 07/01/2008

CRAWFORD, OTTAWA, SANDUSKY, SENECA & WYANDOT

	Rates	Fringes
CARPENTER	$ 23.71	13.28

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* ELEC0008-002 05/29/2023

DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING, PUTNAM, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
CABLE SPLICER	$ 38.98	18.96
ELECTRICIAN	$ 46.38	4.5%+21.96

ELEC0032-003 12/04/2023

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, SHELBY, VAN WERT & WYANDOT (Crawford, Jackson, Marseilles, Mifflin, Ridgeland, Ridge & Salem Townships)

	Rates	Fringes
ELECTRICIAN	$ 35.17	22.82

ELEC0038-002 04/24/2023

CUYAHOGA, GEAUGA (Bainbridge, Chester & Russell Townships) & LORAIN (Columbia Township)

	Rates	Fringes
ELECTRICIAN		
Excluding Sound & Communications Work	$ 43.13	23.31

FOOTNOTES;
a. 6 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; & Christmas Day
b. 1 week's paid vacation for 1 year's service; 2 weeks' paid vacation for 2 or more years' service

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ELEC0038-008 04/24/2023

CUYAHOGA, GEAUGA (Bainbridge, Chester & Russell Townships) & LORAIN (Columbia Township)

	Rates	Fringes
Sound & Communication Technician		
Communications Technician	$ 29.80	13.80
Installer Technician	$ 28.55	13.76

FOOTNOTES;
a. 6 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; & Christmas Day

b. 1 week's paid vacation for 1 year's service; 2 weeks' paid vacation for 2 or more years' service

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ELEC0064-003 11/27/2023

COLUMBIANA (Butler, Fairfield, Perry, Salem & Unity Townships) MAHONING (Austintown, Beaver, Berlin, Boardman, Canfield, Ellsworth, Coitsville, Goshen, Green, Jackson, Poland, Springfield & Youngstown Townships), & TRUMBULL (Hubbard & Liberty Townships)

	Rates	Fringes
ELECTRICIAN	$ 37.90	20.08

ELEC0071-001 01/01/2019

ASHLAND, CHAMPAIGN, CLARK, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HIGHLAND, HOCKING, JACKSON (Coal, Jackson, Liberty, Milton, Washington & Wellston Townships), KNOX, LICKING, MADISON, MARION, MONROE, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, Peepee, Perry & Seal Townships), RICHLAND, ROSS, TUSCARAWAS (Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Salem, Rush, Washington & York Townships), UNION, VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships), and WASHINGTON COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operators	$ 33.62	13.40
Groundmen	$ 24.17	11.32
Linemen & Cable Splicers	$ 38.27	14.42

ELEC0071-004 01/01/2019

AUGLAIZE, CLINTON, DARKE, GREENE, LOGAN, MERCER, MIAMI, MONTGOMERY, PREBLE, and SHELBY COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-005 12/31/2018

ASHTABULA, CUYAHOGA, GEAUGA, LAKE & LORAIN

	Rates	Fringes
LINE CONSTRUCTION: Equipment Operator		
DOT/Traffic Signal & Highway Lighting Projects	$ 32.44	14.10
Municipal Power/Transit Projects	$ 40.10	16.42
LINE CONSTRUCTION: Groundman		
DOT/Traffic Signal &		

Highway Lighting Projects	$ 25.06	12.26
Municipal Power/Transit Projects	$ 31.19	14.11
LINE CONSTRUCTION:		
Linemen/Cable Splicer		
DOT/Traffic Signal & Highway Lighting Projects	$ 36.13	15.03
Municipal Power/Transit Projects	$ 44.56	17.58

ELEC0071-008 01/01/2019

COLUMBIANA, MAHONING, and TRUMBULL COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-010 01/01/2019

BELMONT, CARROLL, HARRISON, HOLMES, JEFFERSON, MEDINA, PORTAGE, STARK, SUMMIT, and WAYNE COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-013 01/01/2019

BROWN, BUTLER, CLERMONT, HAMILTON, and WARREN COUNTIES

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

ELEC0071-014 01/01/2019

ADAMS, ATHENS, GALLIA, JACKSON (Bloomfield, Franklin, Hamilton, Lick, Jefferson, Scioto & Madison Townships), LAWRENCE, MEIGS, PIKE (Camp Creek, Marion, Newton, Scioto, Sunfish & Union Townships), SCIOTO & VINTON (Brown, Knox, Madison, Vinton & Wilkesville Townships)

	Rates	Fringes
Line Construction		
Equipment Operator	$ 33.62	13.40
Groundman	$ 24.17	11.32
Lineman & Cable Splicers	$ 38.27	14.42

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* ELEC0082-002 12/04/2023

CLINTON, DARKE, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN (Wayne, Clear Creek & Franklin Townships)

	Rates	Fringes
ELECTRICIAN	$ 36.00	21.99

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* ELEC0082-006 11/28/2022

CLINTON, DARKE, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN
(Wayne, Clear Creek & Franklin Townships)

	Rates	Fringes
Sound & Communication Technician		
Cable Puller	$ 13.10 **	4.76
Installer/Technician	$ 26.20	13.89

ELEC0129-003 02/27/2023

LORAIN (Except Columbia Township) & MEDINA (Litchfield &
Liverpool Townships)

	Rates	Fringes
ELECTRICIAN	$ 39.30	18.30

ELEC0129-004 02/27/2023

ERIE & HURON (Lyme, Ridgefield, Norwalk, Townsend, Wakeman,
Sherman, Peru, Bronson, Hartland, Clarksfield, Norwich,
Greenfield, Fairfield, Fitchville & New London Townships)

	Rates	Fringes
ELECTRICIAN	$ 39.30	18.30

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* ELEC0141-003 06/01/2023

BELMONT COUNTY

	Rates	Fringes
CABLE SPLICER	$ 30.63	25.87
ELECTRICIAN	$ 35.70	28.87

ELEC0212-003 11/26/2018

BROWN, CLERMONT & HAMILTON

	Rates	Fringes
Sound & Communication Technician	$ 24.35	10.99

ELEC0212-005 06/05/2023

BROWN, CLERMONT, and HAMILTON COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 34.41	21.55

ELEC0245-001 08/29/2022

ALLEN, HARDIN, VAN WERT & WYANDOT (Crawford, Jackson, Marseilles, Mifflin, Richland, Ridge & Salem Townships)

	Rates	Fringes
Line Construction		
Equipment Operator	$ 32.37	26.5%+7.25
Groundman Truck Driver	$ 19.35	7.00+27.25%
Lineman	$ 44.22	7.00+27.25%

FOOTNOTE: a. Half day's Paid Holiday: The last 4 hours of the workday prior to Christmas or New Year's Day

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* ELEC0245-003 01/01/2024

DEFIANCE, FULTON, HANCOCK, HENRY, HURON, LUCAS, OTTAWA, PAULDING, PUTNAM, SANDUSKY, SENECA, WILLIAMS, and WOOD COUNTIES

	Rates	Fringes
Line Construction		
Cable Splicer	$ 52.53	7.75+27%
Groundman/Truck Driver	$ 19.99	7.75+27%
Heli-arc Welding	$ 45.98	7.75+27%
Lineman	$ 45.68	7.75+27%
Operator - Class 1	$ 36.54	7.75+27%
Operator - Class 2	$ 31.98	7.75+27%
Traffic Signal & Lighting Technician	$ 41.11	7.75+27%

FOOTNOTE: a. 6 Observed Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; & Christmas Day. Employees who work on a holiday shall be paid at a rate of double their applicable classified straight-time rates for the work performed on such holiday.

ELEC0245-004 08/28/2023

ERIE COUNTY

	Rates	Fringes
Line Construction		
Cable Splicer	$ 49.14	26.75%+6.75
Cablesplicer	$ 52.76	27%+7.50
Groundman/Truck Driver	$ 20.07	27%+7.50
Lineman	$ 45.88	27%+7.50
Operator - Class 1	$ 36.70	27%+7.50
Operator - Class 2	$ 32.12	27%+7.50

FOOTNOTE: a. 6 Observed Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; & Christmas Day. Employees who work on a holiday shall be paid at a rate of double their applicable classified straight-time rates for the work performed on such holiday.

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* ELEC0246-001 10/30/2023

	Rates	Fringes
ELECTRICIAN	$ 42.50	55%+13.88

FOOTNOTE: a. 1 1/2 Paid Holidays: The last scheduled workday prior to Christmas & 4 hours on Good Friday.

ELEC0306-005 05/29/2023

MEDINA (Brunswick, Chatham, Granger, Guilford, Harrisville, Hinckley, Homer, Lafayette, Medina, Montville, Sharon, Spencer, Wadsworth, Westfield & York Townships), PORTAGE (Atwater, Aurora, Brimfield, Deerfield, Franklin, Mantua, Randolph, Ravenna, Rootstown, Shalersville, Streetsboro & Suffield Townships), SUMMIT & WAYNE (Baughman, Canaan, Chester, Chippewa, Congress, Green, Milton, & Wayne Townships)

	Rates	Fringes
CABLE SPLICER	$ 36.87	16.56
ELECTRICIAN	$ 40.15	5.25%+20.85

ELEC0317-002 05/29/2023

GALLIA & LAWRENCE

	Rates	Fringes
CABLE SPLICER	$ 32.68	18.13
ELECTRICIAN	$ 37.15	28.48

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* ELEC0540-005 01/01/2024

CARROLL (Northern half, including Fox, Harrison, Rose & Washington Townhships), COLUMBIANA (Knox Township), HOLMES, MAHONING (Smith Township), STARK, TUSCARAWAS (North of Auburn, Clay, Rush & York Townships), and WAYNE (South of Baughman, Chester, Green & Wayne Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 36.96	28.18

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* ELEC0573-003 11/27/2023

ASHTABULA (Colebrook, Wayne, Williamsfield, Orwell & Windsor Townships), GEAUGA (Auburn, Middlefield, Parkman & Troy Townships), MAHONING (Milton Township), PORTAGE (Charlestown, Edinburg, Freedom, Hiram, Nelson, Palmyra, Paris & Windham Townships), and TRUMBULL (Except Liberty & Hubbard Townships)

	Rates	Fringes
ELECTRICIAN	$ 40.40	22.08

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* ELEC0575-001 05/29/2023

ADAMS, FAYETTE, HIGHLAND, HOCKING, JACKSON (Bloomfield, Franklin, Hamilton, Jefferson, Lick, Madison, Scioto, Coal, Jackson, Liberty, Milton & Washington Townships), PICKAWAY

(Deer Creek, Perry, Pickaway, Salt Creek & Wayne Townships), PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, PeePee, Perry, Seal, Camp Creek, Newton, Scioto, Sunfish, Union & Marion Townships), ROSS, SCIOTO & VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships)

	Rates	Fringes
ELECTRICIAN	$ 37.00	22.26

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* ELEC0648-001 08/29/2023

BUTLER and WARREN COUNTIES (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union & Washington Townships)

	Rates	Fringes
CABLE SPLICER	$ 30.50	18.23
ELECTRICIAN	$ 34.00	21.98

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* ELEC0673-004 01/01/2024

ASHTABULA (Excluding Orwell, Colebrook, Williamsfield, Wayne & Windsor Townships), GEAUGA (Burton, Chardon, Claridon, Hambden, Huntsburg, Montville, Munson, Newbury & Thompson Townships) and LAKE COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 33.81	21.47
ELECTRICIAN	$ 37.38	23.75

ELEC0683-002 05/29/2023

CHAMPAIGN, CLARK, DELAWARE, FAIRFIELD, FRANKLIN, MADISON, PICKAWAY (Circleville, Darby, Harrison, Jackson, Madison, Monroe, Muhlenberg, Scioto, Walnut & Washington Townships), and UNION COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 38.75	24.19
ELECTRICIAN	$ 37.75	24.16

ELEC0688-003 05/30/2022

ASHLAND, CRAWFORD, HURON (Richmond, New Haven, Ripley & Greenwich Townships), KNOX (Liberty, Clinton, Union, Howard, Monroe, Middleberry, Morris, Wayne, Berlin, Pike, Brown & Jefferson Townships), MARION, MORROW, RICHLAND and WYANDOT (Sycamore, Crane, Eden, Pitt, Antrim & Tymochtee Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 32.30	21.83

ELEC0972-002 06/01/2023

ATHENS, MEIGS, MONROE, MORGAN, NOBLE, VINTON (Brown, Knox,

Madison, Vinton & Wilkesville Townships), and WASHINGTON COUNITES

	Rates	Fringes
CABLE SPLICER	$ 35.70	30.26
ELECTRICIAN	$ 35.45	30.25

ELEC1105-001 05/29/2023

COSHOCTON, GUERNSEY, KNOX (Jackson, Clay, Morgan, Miller, Milford, Hilliar, Butler, Harrison, Pleasant & College Townships), LICKING, MUSKINGUM, PERRY, and TUSCARAWAS (Auburn, York, Clay, Jefferson, Rush, Oxford, Washington, Salem, Perry & Bucks Townships) COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 36.45	24.22

ENGI0018-003 05/01/2019

ASHTABULA, CUYAHOGA, ERIE, GEAUGA, LAKE, LORAIN, MEDINA, PORTAGE, and SUMMIT COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 38.63	15.20
GROUP 2	$ 38.53	15.20
GROUP 3	$ 37.49	15.20
GROUP 4	$ 36.27	15.20
GROUP 5	$ 30.98	15.20
GROUP 6	$ 38.88	15.20
GROUP 7	$ 39.13	15.20

OPERATING ENGINEER CLASSIFICATIONS

GROUP 1 - Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Capacity); Concrete Pump; Crane (All Types, Including Boom Truck, Cherry Picker); Crane-Compact, Track or Rubber over 4,000 lbs. capacity; Cranes-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment (All Types); Gradall; Helicopter Crew (Operator-Hoist or Winch); Hoe (all types); Hoisting Engine on Shaft or Tunnel Work; Hydraulic Gantry (Lifting System); Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine (All Types); Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Rail Tamper (with auto lifting & aligning device); Refrigerating Machine (Freezer Operation); Rotary Drill, on Caisson work; Rough Terrain Fork Lift with Winch/Hoist; Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24"" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; Wheel Excavator; and Asphalt Plant Engineer (Cleveland District

Only).

GROUP 2 - Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48""; Bulldozer; Endloader; Horizontal Directional Drill (Over 50,000 ft lbs thrust); Hydro Milling Machine; Kolman-type Loader (production type-Dirt); Lead Greaseman; Lighting & Traffic Signal Installation Equipment (includes all groups or classifications); Material Transfer Equipment (Shuttle Buggy) Asphalt; Pettibone-Rail Equipment; Power Grader; Power Scraper; Push Cat; Rotomill (all), Grinders & Planers of All types; Trench Machine (24"" wide & under); Vermeer type Concrete Saw; and Maintenance Operators (Portage and Summit Counties Only).

GROUP 3 - A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer (Portage and Summit Counties Only); Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drills (all types); Locomotive (narrow gauge); Material Hoist/Elevator; Mixer, Concrete (more than one bag capacity); Mixer, one bag capacity (Side Loader); Power Boiler (Over 15 lbs. Pressure) Pump Operator installing & operating Well Points; Pump (4"" & over discharge); Roller, Asphalt; Rotovator (lime soil stabilizer); Switch & Tie Tampers (without lifting & aligning device); Utility Operator (Small equipment); Welding Machines; and Railroad Tie Inserter/Remover; Articulating/straight bed end dumps if assigned (minus $4.00 per hour.

GROUP 4 - Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48"" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway); Finishing Machine; Fireperson, Floating Equipment (all types); Forklift; Form Trencher; Hydro Hammer expect masonary; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); and Vibratory Compactor with Integral Power.

GROUP 5 - Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt Plant); Generator; Masonry Fork Lift; Inboard-Outboard Motor Boat Launch; Oil Heater (asphalt plant); Oiler/Helper; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4"" discharge); Signalperson; Tire Repairperson; VAC/ALLS; Cranes - Compact, track or rubber under 4,000 pound capacity; fueling and greasing; and Chainmen.

GROUP 6 - Master Mechanic & Boom from 150 to 180.

GROUP 7 - Boom from 180 and over.

ENGI0018-004 05/01/2019

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, and YANDOT COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 37.14	15.20
GROUP 2	$ 37.02	15.20
GROUP 3	$ 35.98	15.20
GROUP 4	$ 34.80	15.20
GROUP 5	$ 29.34	15.20
GROUP 6	$ 37.39	15.20
GROUP 7	$ 37.64	15.20

OPERATING ENGINEER CLASSIFICATIONS

GROUP 1 - Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Capacity); Concrete Pump; Crane (All Types, Including Boom Truck, Cherry Picker); Crane-Compact, Track or Rubber over 4,000 lbs. capacity; Cranes-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment (All Types); Gradall; Helicopter Crew (Operator-Hoist or Winch); Hoe (all types); Hoisting Engine on Shaft or Tunnel Work; Hydraulic Gantry (Lifting System); Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine (All Types); Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Rail Tamper (with auto lifting & aligning device); Refrigerating Machine (Freezer Operation); Rotary Drill, on Caisson work; Rough Terrain Fork Lift with Winch/Hoist; Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24"" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; and Wheel Excavator.

GROUP 2 - Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48""; Bulldozer; Endloader; Hydro Milling Machine; Horizontal Directional Drill (over 50,000 ft. lbs. thrust);Kolman-type Loader (production type-Dirt); Lead Greaseman; Lighting & Traffic Signal Installation Equipment (includes all groups or classifications); Material Transfer Equipment (Shuttle Buggy) Asphalt; Pettibone-Rail Equipment; Power Grader; Power Scraper; Push Cat; Rotomill (all), Grinders & Planers of All types; Trench Machine (24"" wide & under); and Vermeer type Concrete Saw.

GROUP 3 - A-Frame; Air Compressor on Tunnel Work (low

pressure); Asphalt Plant Engineer; Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drills (all types); Locomotive (narrow gauge); Material Hoist/Elevator; Mixer, Concrete (more than one bag capacity); Mixer, one bag capacity (Side Loader); Power Boiler (Over 15 lbs. Pressure) Pump Operator installing & operating Well Points; Pump (4"" & over discharge); Railroad Tie Inserter/Remover; Roller, Asphalt; Rotovator (lime soil stabilizer); Switch & Tie Tampers (without lifting & aligning device); Utility Operator (Small equipment); and Welding Machines; Artiaculating/straight bed end dumps if assigned (minus $4.00 per hour.

GROUP 4 - Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48"" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway); Finishing Machine; Fireperson, Floating Equipment (all types); Fork Lift; Form Trencher; Hydro Hammer expect masonary; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); and Vibratory Compactor with Integral Power.

GROUP 5 - Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt Plant); Generator; Masonary Forklift; Inboard-Outboard Motor Boat Launch; Oil Heater (asphalt plant); Oiler/Helper; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4"" discharge); Signalperson; Tire Repairperson; VAC/ALLS; Cranes - Compact, track or rubber under 4,000 pound capacity; fueling and greasing; and Chainmen.

GROUP 6 - Master Mechanic & Boom from 150 to 180.

GROUP 7 - Boom from 180 and over.

ENGI0066-023 06/01/2017

COLUMBIANA, MAHONING & TRUMBULL COUNTIES

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 1 - A & B	$ 39.23	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 2 - A & B	$ 38.90	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 3 - A & B	$ 34.64	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 4 - A & B	$ 30.70	19.66
ASBESTOS; HAZARDOUS/TOXIC WASTE PROJECTS		
GROUP 5 - A & B	$ 27.30	19.66

HAZARDOUS/TOXIC WASTE PROJECTS GROUP 1 - C & D	$ 35.96	19.66
HAZARDOUS/TOXIC WASTE PROJECTS GROUP 2 - C & D	$ 35.66	19.66
HAZARDOUS/TOXIC WASTE PROJECTS GROUP 3 - C & D	$ 31.76	19.66
HAZARDOUS/TOXIC WASTE PROJECTS GROUP 4 - C & D	$ 28.14	19.66
HAZARDOUS/TOXIC WASTE PROJECTS GROUP 5 - C & D	$ 25.03	19.66
ALL OTHER WORK GROUP 1	$ 32.69	19.66
ALL OTHER WORK GROUP 2	$ 32.42	19.66
ALL OTHER WORK GROUP 3	$ 28.87	19.66
ALL OTHER WORK GROUP 4	$ 25.58	19.66
ALL OTHER WORK GROUP 5	$ 22.75	19.66

GROUP 1 - Rig, Pile Driver or Caisson Type; & Rig, Pile Hydraulic Unit Attached

GROUP 2 - Asphalt Heater Planer; Backfiller with Drag Attachment; Backhoe; Backhoe with Shear attached; Backhoe-Rear Pivotal Swing; Batch Plant-Central Mix Concrete; Batch Plant, Portable concrete; Berm Builder-Automatic; Boat Derrick; Boat-Tug; Boring Machine Attached to Tractor; Bullclam; Bulldozer; C.M.I. Road Builder & Similar Type; Cable Placer & Layer; Carrier-Straddle; Carryall-Scraper or Scoop; Chicago Boom; Compactor with Blade Attached; Concrete Saw (Vermeer or similar type); Concrete Spreader Finisher; Combination, Bidwell Machine; Crane; Crane-Electric Overhead; Crane-Rough Terrain; Crane-Side Boom; Crane-Truck; Crane-Tower; Derrick-Boom; Derrick-Car; Digger-Wheel (Not trencher or road widener); Double Nine; Drag Line; Dredge; Drill-Kenny or Similar Type; Easy Pour Median Barrier Machine (or similar type); Electromatic; Frankie Pile; Gradall; Grader; Gurry; Self-Propelled; Heavy Equipment Robotics Operator/Mechanic; Hoist-Monorail; Hoist-Stationary & Mobile Tractor; Hoist, 2 or 3 drum; Horizontal Directional Drill Operator; Jackall; Jumbo Machine; Kocal & Kuhlman; Land-Seagoing Vehicle; Loader, Elevating; Loader, Front End; Loader, Skid Steer; Locomotive; Mechanic/Welder; Metro Chip Harvester with Boom; Mucking Machine; Paver-Asphalt Finishing Machine; Paver-Road Concrete; Paver-Slip Form (C.M.I. or similar); Place Crete Machine with Boom; Post Driver (Carrier mounted); Power Driven Hydraulic Pump & Jack (When used in Slip Form or Lift Slab Construction); Pump Crete Machine; Regulator-Ballast; Hydraulic Power Unit not attached to Rig for Pile Drillings; Rigs-Drilling; Roto Mill or similar Full Lane (8' Wide & Over); Roto Mill or similar type (Under 8'); Shovel; Slip Form Curb Machine; Speedwing; Spikemaster; Stonecrusher; Tie Puller & Loader; Tie Tamper; Tractor-Double Boom; Tractor with Attachments; Truck-Boom; Truck-Tire; Trench Machine; Tunnel Machine (Mark 21 Java or similar); & Whirley (or similar type)

GROUP 3 - Asphalt Plant; Bending Machine (Pipeline or similar type); Boring machine, Motor Driven; Chip Harvester without Boom; Cleaning Machine, Pipeline Type; Coating Machine, Pipeline Type; Compactor; Concrete Belt Placer; Concrete Finisher; Concrete Planer or Asphalt; Concrete Spreader; Elevator; Fork Lift (Home building only); Fork lift & Lulls; Fork Lift Walk Behind (Hoisting over 1 buck high); Form Line Machine; Grease Truck operator; Grout Pump; Gunnite Machine; Horizontal Directional Drill Locator; Single Drum Hoist with or without Tower; Huck Bolting Machine; Hydraulic Scaffold (Hoisting building materials); Paving Breaker (Self-propelled or Ridden); Pipe Dream; Pot Fireperson (Power Agitated); Refrigeration Plant; Road Widener; Roller; Sasgen Derrick; Seeding Machine; Soil Stabilizer (Pump type); Spray Cure Machine, Self-Propelled; Straw Blower Machine; Sub-Grader; Tube Finisher or Broom C.M.I. or similar type; & Tugger Hoist

GROUP 4 - Air Curtain Destructor & Similar Type; Batch Plant-Job Related; Boiler Operator; Compressor; Conveyor; Curb Builder, self-propelled; Drill Wagon; Generator Set; Generator-Steam; Heater-Portable Power; Hydraulic Manipulator Crane; Jack-Hydraulic Power driven; Jack-Hydraulic (Railroad); Ladavator; Minor Machine Operator; Mixer-Concrete; Mulching Machine; Pin Puller; Power Broom; Pulverizer; Pump; Road Finishing Machine (Pull Type); Saw-Concrete-Self-Propelled (Highway Work); Signal Person; Spray Cure Machine-Motor Powered; Stump Cutter; Tractor; Trencher Form; Water Blaster; Steam Jenny; Syphon; Vibrator-Gasoline; & Welding Machine

GROUP 5 - Brakeperson; Fireperson; & Oiler

IRON0017-002 05/01/2023

ASHTABULA (North of Route 6, starting at the Geauga County Line, proceeding east to State Route 45), CUYAHOGA, ERIE (Eastern 2/3), GEAUGA, HURON (East of a line drawn from the north border through Monroeville & Willard), LAKE, LORAIN, MEDINA (North of Old Rte. #224), PORTAGE (West of a line from Middlefield to Shalersville to Deerfield), and SUMMIT (North of Old Rte. #224, including city limits of Barberton) COUNTIES

	Rates	Fringes
IRONWORKER		
Ornamental, Reinforcing, & Structural	$ 35.83	28.01

IRON0017-010 05/01/2023

ASHTABULA (Eastern part from Lake Erie on the north to route #322 on the south to include Conneaut, Kingsville, Sheffield, Denmark, Dorset, Cherry Valley, Wayne, Monroe, Pierpont, Richmond, Andover & Williamsfield Townships)

	Rates	Fringes
IRONWORKER		
Structural, including metal building erection &		

Reinforcing	$ 35.83	28.01

IRON0044-001 06/01/2022

ADAMS (Western Part), BROWN, BUTLER (Southern Part), CLERMONT, CLINTON (South of a line drawn from Blanchester to Lynchburg), HAMILTON, HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) and WARREN (South of a line drawn from Blanchester through Morrow to the west county line) COUNTIES

	Rates	Fringes
IRONWORKER, REINFORCING	$ 32.37	22.30
Beyond 30-mile radius of Hamilton County Courthouse	$ 28.67	21.20
Up to & including 30-mile radius of Hamilton County Courthouse	$ 27.60	20.70

IRON0044-002 06/01/2023

CLINTON (South of a line drawn from Blanchester to Lynchburg), HAMILTON, HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) & WARREN (South of a line drawn from Blanchester through Morrow to the west county line)

	Rates	Fringes
IRONWORKER		
Fence Erector	$ 30.75	23.30
Ornamental; Structural	$ 32.37	23.30

IRON0055-003 07/01/2023

CRAWFORD (Area Between lines drawn from where Hwy #598 & #30 meet through N. Liberty to the northern border & from said Hwy junction point due west to the border), DEFIANCE (S. of a line drawn from where Rte. #66 meets the northern line through Independence to the eastern county border), ERIE (Western 1/3), FULTON, HANCOCK, HARDIN (North of a line drawn from Maysville to a point 4 miles south of the northern line on the eastern line), HENRY, HURON (West of a line drawn from the northern border through Monroeville & Willard), LUCAS, OTTAWA, PUTNAM (East of a line drawn from the northern border down through Miller City to where #696 meets the southern border), SANDUSKY, SENECA, WILLIAMS (East of a line drawn from Pioneer through Stryker to the southern border), WOOD & WYANDOT (North of Rte. #30)

	Rates	Fringes
IRONWORKER		
Fence Erector	$ 25.40	23.87
Flat Road Mesh	$ 29.77	21.30
Tunnels & Caissons Under Pressure	$ 29.77	21.30
All Other Work	$ 34.25	28.20

IRON0147-002 06/01/2023

ALLEN (Northern half), DEFIANCE (Northern part, excluding south of a line drawn from where Rte. #66 meets the northern line through Independence to the eastern county border), MERCER (Northern half), PAULDING, PUTNAM (Western part, excluding east of a line drawn from the northern border down through Miller City to where #696 meets the southern border), VAN WERT, and WILLIAMS (Western part, excluding east of a line drawn from Pioneer through Stryker to the southern border) COUNTIES

	Rates	Fringes
IRONWORKER	$ 33.00	25.59

IRON0172-002 06/01/2023

CHAMPAIGN (Eastern one-third), CLARK (Eastern one-fourth), COSHOCTON (West of a line beginning at the northwestern county line going through Walhonding & Tunnel Hill to the southern county line), CRAWFORD (South of Rte. #30), DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HARDIN (Excluding a line drawn from Roundhead to Maysville), HIGHLAND (Eastern one-fifth), HOCKING, JACKSON (Northern half), KNOX, LICKING, LOGAN (Eastern one-third), MADISON, MARION, MORROW, MUSKINGUM (West of a line starting at Adams Mill going to Adamsville & going from Adamsville through Blue Rock to the southern border), PERRY, PICKAWAY, PIKE (Northern half), ROSS, UNION, VINTON and WYANDOT (South of Rte. #30) COUNTIES

	Rates	Fringes
IRONWORKER	$ 34.07	22.55

IRON0207-004 06/01/2023

ASHTABULA (Southern part starting at the Geauga County line), COLUMBIANA (E. of a line from Damascus to Highlandtown), MAHONING (N. of Old Route #224), PORTAGE (E. of a line from Middlefield to Shalersville to Deerfield) & TRUMBULL

	Rates	Fringes
IRONWORKER		
Layout; Sheeter	$ 34.00	27.16
Ornamental; Reinforcing; Structural	$ 33.00	27.16
Ornamental; Reinforcing	$ 28.92	25.61

IRON0290-002 06/01/2023

ALLEN (Southern half), AUGLAIZE, BUTLER (North of a line drawn from east to the west county line going through Oxford, Darrtown & Woodsdale), CHAMPAIGN (Excluding east of a line drawn from Catawla to the point where #68 intersects the northern county line), CLARK (Western two-thirds), CLINTON (Excluding south of a line drawn from Blanchester to Lynchburg), DARKE, GREENE, HIGHLAND (Inside lines drawn from Marshall to Lynchburg & from the northern county line through East Monroe to Marshall), LOGAN (West of a line drawn from West Liberty to where the northern county line meets the western county line of Hardin), MERCER (Southern half), MIAMI,

MONTGOMERY, PREBLE, SHELBY & WARREN (Excluding south of a line drawn from Blanchester through Morrow to the western county line) COUNTIES

	Rates	Fringes
IRONWORKER	$ 32.69	24.05

IRON0549-003 12/01/2022

BELMONT, GUERNSEY, HARRISON, JEFFERSON, MONROE & MUSKINGUM (Excluding portion west of a line starting at Adams Mill going to Adamsville and going from Adamsville through Blue Rock to the south border)

	Rates	Fringes
IRONWORKER	$ 35.19	25.66

IRON0550-004 05/01/2023

ASHLAND, CARROLL, COLUMBIANA (W. of a line from Damascus to Highlandtown), COSHOCTON (E. of a line beginning at NW Co. line going through Walhonding & Tunnel Hill to the South Co. line), HOLMES, HURON (S. of Old Rte. #224), MAHONING (S. of Old Rte. #224), MEDINA (S. of Old Rte. #224), PORTAGE (S. of Old Rte. #224), RICHLAND, STARK, SUMMIT (S. of Old Rte. #224, Excluding city limits of Barberton), TUSCARAWAS, & WAYNE

	Rates	Fringes
Ironworkers:Structural, Ornamental and Reinforcing	$ 33.00	22.27

IRON0769-004 06/01/2023

ADAMS (Eastern Half), GALLIA, JACKSON (Southern Half), LAWRENCE & SCIOTO

	Rates	Fringes
IRONWORKER	$ 36.16	28.34

IRON0787-003 12/01/2023

ATHENS, MEIGS, MORGAN, NOBLE, and WASHINGTON COUNTIES

	Rates	Fringes
IRONWORKER	$ 33.30	23.95

LABO0265-008 05/01/2023

	Rates	Fringes
LABORER ASHTABULA, ERIE, HURON, LORAIN, LUCAS, MAHONING, MEDINA, OTTAWA, PORTAGE, SANDUSKY, STARK, SUMMIT, TRUMBULL & WOOD COUNTIES		

GROUP 1	$ 35.05	13.70
GROUP 2	$ 35.22	13.70
GROUP 3	$ 35.55	13.70
GROUP 4	$ 36.00	13.70
CUYAHOGA AND GEAUGA COUNTIES ONLY: SEWAGE PLANTS, WASTE PLANTS, WATER TREATMENT FACILITIES, PUMPING STATIONS, & ETHANOL PLANTS CONSTRUCTION	$ 37.66	13.70
CUYAHOGA, GEAUGA & LAKE COUNTIES		
GROUP 1	$ 36.28	13.70
GROUP 2	$ 36.45	13.70
GROUP 3	$ 36.78	13.70
GROUP 4	$ 37.23	13.70
REMAINING COUNTIES OF OHIO		
GROUP 1	$ 34.62	13.70
GROUP 2	$ 34.79	13.70
GROUP 3	$ 35.12	13.70
GROUP 4	$ 35.57	13.70

LABORER CLASSIFICATIONS

GROUP 1 - Asphalt Laborer; Carpenter Tender; Concrete Curing Applicator; Dump Man (Batch Truck); Guardrail and Fence Installer; Joint Setter; Laborer (Construction); Landscape Laborer; Mesh Handlers & Placer; Right-of-way Laborer; Riprap Laborer & Grouter; Scaffold Erector; Seal Coating; Surface Treatment or Road Mix Laborer; Sign Installer; Slurry Seal; Utility Man; Bridge Man; Handyman; Waterproofing Laborer; Flagperson; Hazardous Waste (level D); Diver Tender; Zone Person & Traffic Control

GROUP 2 - Asphalt Raker; Concrete Puddler; Kettle Man Pipeline); Machine Driven Tools (Gas, Electric, Air); Mason Tender; Brick Paver; Mortar Mixer; Power Buggy or Power Wheelbarrow; Paint Striper; Sheeting & Shoring Man; Surface Grinder Man; Plastic Fusing Machine Operator; Pug Mill Operator; & Vacuum Devices (wet or dry); Rodding Machine Operator; Diver; Screwman or Paver; Screed Person; Water Blast, Hand Held Wand; Pumps 4"" & Under (Gas, Air or Electric) & Hazardous Waste (level C); Air Track and Wagon Drill; Bottom Person; Cofferdam (below 25 ft. deep); Concrete Saw Person; Cutting with Burning Torch; Form Setter; Hand Spiker (Railroad); Pipelayer; Tunnel Laborer (without air) & Caisson; Underground Person (working in Sewer and Waterline, Cleaning, Repairing & Reconditioning); Sandblaster Nozzle Person; & Hazardous Waste (level B)

GROUP 3 - Blaster; Mucker; Powder Person; Top Lander; Wrencher (Mechanical Joints & Utility Pipeline); Yarner; Hazardous Waste (level A); Concrete Specialist; Concrete Crew in Tunnels (With Air-pressurized - $1.00 premium); Curb Setter & Cutter; Grade Checker; Utility Pipeline Tapper; Waterline; and Caulker

GROUP 4 - Miner (With Air-pressurized - $1.00 premium); & Gunite Nozzle Person

TUNNEL LABORER WITH AIR-PRESSURIZED ADD $1.00 TO BASE RATE

SIGNAL PERSON WILL RECEIVE THE RATE EQUAL TO THE RATE PAID THE LABORER CLASSIFICATION FOR WHICH HE OR SHE IS SIGNALING.

PAIN0006-002 05/01/2023

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, LORAIN, PORTAGE (N. of the East-West Turnpike) & SUMMIT (N. of the East-West Turnpike)

	Rates	Fringes
PAINTER		
COMMERCIAL NEW WORK; REMODELING; & RENOVATIONS		
GROUP 1	$ 30.75	18.95
GROUP 2	$ 31.15	18.95
GROUP 3	$ 31.45	18.95
GROUP 4	$ 37.01	18.95
COMMERCIAL REPAINT		
GROUP 1	$ 29.25	18.95
GROUP 2	$ 29.65	18.95
GROUP 3	$ 29.95	18.95

PAINTER CLASSIFICATIONS - COMMERCIAL NEW WORK; REMODELING; & RENOVATIONS

GROUP 1 - Brush; & Roller

GROUP 2 - Sandblasting & Buffing

GROUP 3 - Spray Painting; Closed Steel Above 55 feet; Bridges & Open Structural Steel; Tanks - Water Towers; Bridge Painters; Bridge Riggers; Containment Builders

GROUP 4 - Bridge Blaster

PAINTER CLASSIFICATIONS - COMMERCIAL REPAINT

GROUP 1 - Brush; & Roller

GROUP 2 - Sandblasting & Buffing

GROUP 3 - Spray Painting

PAIN0007-002 07/01/2023

FULTON, HENRY, LUCAS, OTTAWA (Excluding Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genova) & WOOD

	Rates	Fringes
PAINTER		
NEW COMMERCIAL WORK		
GROUP 1	$ 28.59	20.04
GROUP 2	$ 29.59	20.04
GROUP 3	$ 29.59	20.04
GROUP 4	$ 29.59	20.04
GROUP 5	$ 29.59	20.04
GROUP 6	$ 29.59	20.04
GROUP 7	$ 29.59	20.04
GROUP 8	$ 29.59	20.04
GROUP 9	$ 29.59	20.04

REPAINT IS 90% OF JR

PAINTER CLASSIFICATIONS

GROUP 1 - Brush; Spray & Sandblasting Pot Tender

GROUP 2 - Refineries & Refinery Tanks; Surfaces 30 ft. or over where material is applied to or labor performed on above ground level (exterior), floor level (interior)

GROUP 3 - Swing Stage & Chair

GROUP 4 - Lead Abatement

GROUP 5 - All Methods of Spray

GROUP 6 - Solvent-Based Catalized Epoxy Materials of 2 or More Component Materials, to include Solvent-Based Conversion Varnish (excluding water based)

GROUP 7 - Spray Solvent Based Material; Sand & Abrasive Blasting

GROUP 8 - Towers; Tanks; Bridges; Stacks Over 30 Feet

GROUP 9 - Epoxy Spray (excluding water based)

PAIN0012-008 05/01/2019

BUTLER COUNTY

	Rates	Fringes
PAINTER		
GROUP 1	$ 21.95	10.20
GROUP 2	$ 25.30	10.20
GROUP 3	$ 25.80	10.20
GROUP 4	$ 26.05	10.20
GROUP 5	$ 26.30	10.20

PAINTER CLASSIFICATIONS

GROUP 1: Bridge Equipment Tender; Bridge/Containment Builder

GROUP 2: Brush & Roller

GROUP 3: Spray

GROUP 4: Sandblasting; & Waterblasting

GROUP 5: Elevated Tanks; Steeplejack Work; Bridge; & Lead Abatement

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PAIN0012-010 05/01/2019

BROWN, CLERMONT, CLINTON, HAMILTON & WARREN

	Rates	Fringes
PAINTER		
HEAVY & HIGHWAY BRIDGES- GUARDRAILS-LIGHTPOLES-		

STRIPING
Bridge Equipment Tender
and Containment Builder....$ 21.95 10.20
Bridges when highest
point of clearance is 60
feet or more; & Lead
Abatement Projects.....$ 26.30 10.20
Brush & Roller.....$ 25.30 10.20
Sandblasting & Hopper
Tender; Water Blasting.....$ 26.05 10.20
Spray.....$ 25.80 10.20

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* PAIN0093-001 12/01/2023

ATHENS, GUERNSEY, HOCKING, MONROE, MORGAN, NOBLE and
WASHINGTON COUNTIES

	Rates	Fringes
PAINTER		
Bridges; Locks; Dams; Tension Towers; & Energized Substations	$ 35.45	23.69
Power Generating Facilities	$ 32.30	23.69

PAIN0249-002 05/01/2023

CLARK, DARKE, GREENE, MIAMI, MONTGOMERY & PREBLE

	Rates	Fringes
PAINTER		
GROUP 1 - Brush & Roller	$ 26.23	12.56
GROUP 2 - Swing, Scaffold Bridges; Structural Steel; Open Acid Tank; High Tension Electrical Equipment; & Hot Pipes	$ 26.23	12.56
GROUP 3 - Spray; Sandblast; Steamclean; Lead Abatement	$ 26.98	12.56
GROUP 4 - Steeplejack Work	$ 27.18	12.56
GROUP 5 - Coal Tar	$ 27.73	12.56
GROUP 6 - Bridge Equipment Tender & or Containment Builder	$ 34.94	12.56
GROUP 7 - Tanks, Stacks & Towers	$ 29.87	12.56
GROUP 8 - Bridge Blaster, Rigger	$ 37.94	12.56

PAIN0356-002 09/01/2009

KNOX, LICKING, MUSKINGUM, and PERRY

	Rates	Fringes
PAINTER		
Bridge Equipment Tenders and Containment Builders	$ 27.93	7.25
Bridges; Blasters; andRiggers	$ 34.60	7.25
Brush and Roller	$ 20.93	7.25
Sandblasting; Steam		

Cleaning; Waterblasting; and Hazardous Work	$ 25.82	7.25
Spray	$ 21.40	7.25
Structural Steel and Swing Stage	$ 25.42	7.25
Tanks; Stacks; and Towers	$ 28.63	7.25

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* PAIN0438-002 12/01/2023

BELMONT, HARRISON and JEFFERSON COUNTIES

	Rates	Fringes
PAINTER		
Bridges, Locks, Dams, Tension Towers & Energized Substations	$ 36.09	19.49
Power Generating Facilities	$ 32.94	19.49

PAIN0476-001 06/01/2023

COLUMBIANA, MAHONING, and TRUMBULL COUNITES

	Rates	Fringes
PAINTER		
GROUP 1	$ 27.49	17.06
GROUP 2	$ 34.12	17.06
GROUP 3	$ 27.70	17.06
GROUP 4	$ 27.99	17.06
GROUP 5	$ 28.14	17.06
GROUP 6	$ 28.39	17.06
GROUP 7	$ 29.49	17.06

PAINTER CLASSIFICATIONS:

GROUP 1: Painters, Brush & Roller

GROUP 2: Bridges

GROUP 3: Structural Steel

GROUP 4: Spray, Except Bar Joist/Deck

GROUP 5: Epoxy/Mastic; Spray- Bar Joist/Deck; Working Above 50 Feet; and Swingstages

GROUP 6: Tanks; Sandblasting

GROUP 7: Towers; Stacks

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* PAIN0555-002 11/01/2023

ADAMS, HIGHLAND, JACKSON, PIKE & SCIOTO

	Rates	Fringes
PAINTER		
GROUP 1	$ 32.18	20.29
GROUP 2	$ 33.81	20.29
GROUP 3	$ 35.44	20.29
GROUP 4	$ 38.63	20.29

PAINTER CLASSIFICATIONS

GROUP 1 - Containment Builder

GROUP 2 - Brush; Roller; Power Tools, Under 40 feet

GROUP 3 - Sand Blasting; Spray; Steam Cleaning; Pressure Washing; Epoxy & Two Component Materials; Lead Abatement; Hazardous Waste; Toxic Materials; Bulk & Storage Tanks of 25,000 Gallon Capacity or More; Elevated Tanks

GROUP 4 - Stacks; Bridges

PAIN0639-001 05/01/2011

	Rates	Fringes
Sign Painter & Erector	$ 20.61	3.50+a+b+c

FOOTNOTES: a. 7 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; Christmas Day & 1 Floating Day
b. Vacation Pay: After 1 year's service - 5 days' paid vacation; After 2, but less than 10 years' service - 10 days' paid vacation; After 10, but less than 20 years' service - 15 days' paid vacation; After 20 years' service - 20 days' paid vacation
c. Funeral leave up to 3 days maximum paid leave for death of mother, father, brother, sister, spouse, child, mother-in-law, father-in-law, grandparent and inlaw provided employee attends funeral

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PAIN0788-002 06/01/2023

ASHLAND, CRAWFORD, ERIE, HANCOCK, HURON, MARION, MORROW, OTTAWA (Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genoa), RICHLAND, SANDUSKY, SENECA & WYANDOT

	Rates	Fringes
PAINTER		
Brush & Roller	$ 25.78	17.12
Structural Steel	$ 27.38	17.12

WINTER REPAINT: Between December 1 to March 31 - 90%JR

$.50 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE CLASSIFICATION OF WORK:

While working swingstage, boatswain chair, needle beam and horizontal cable. While operating sprayguns, sandblasting, cobblasting and high pressure waterblasting (4000psi).

$1.00 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE CLASSIFICATION OF WORK:

For the application of catalized epoxy, including latex epoxy that is deemed hazardous, lead abatement, or for work or material where special precautions beyond normal work duties must be taken. For working on stacks, tanks, and towers over 40 feet in height.

PAIN0813-005 12/01/2008

GALLIA, LAWRENCE, MEIGS & VINTON

	Rates	Fringes
PAINTER		
Base Rate	$ 24.83	10.00
Bridges, Locks, Dams & Tension Towers	$ 27.83	10.00

PAIN0841-001 06/01/2023

MEDINA, PORTAGE (South of and including Ohio Turnpike), and SUMMIT (South of and including Ohio Turnpike) COUNTIES

	Rates	Fringes
Painters:		
GROUP 1	$ 30.18	15.50
GROUP 2	$ 30.83	15.50
GROUP 3	$ 30.93	15.50
GROUP 4	$ 31.03	15.50
GROUP 5	$ 31.43	15.50
GROUP 6	$ 39.20	11.75
GROUP 7	$ 31.68	15.50

PAINTER CLASSIFICATIONS:

GROUP 1 - Brush, Roller & Paperhanger

GROUP 2 - Epoxy Application

GROUP 3 - Swing Scaffold, Bosum Chair, & Window Jack

GROUP 4 - Spray Gun Operator of Any & All Coatings

GROUP 5 - Sandblast, Painting of Standpipes, etc. from Scaffolds, Bridge Work and/or Open Structural Steel, Standpipes and/or Water Towers

GROUP 6 - Public & Commerce Transportation, Steel or Galvanized, Bridges, Tunnels & Related Support Items (concrete)

GROUP 7 - Synthetic Exterior, Drywall Finisher and/or Taper, Drywall Finisher and Follow-up Man Using Automatic Tools

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PAIN0841-002 06/01/2022

CARROLL, COSHOCTON, HOLMES, STARK, TUSCARAWAS & WAYNE

	Rates	Fringes
PAINTER		
Bridges; Towers, Poles & Stacks; Sandblasting Steel; Structural Steel & Metalizing	$ 23.50	15.45
Brush & Roller	$ 28.18	15.45
Spray; Tank Interior & Exterior	$ 23.50	15.45

PAIN1020-002 07/01/2023

ALLEN, AUGLAIZE, CHAMPAIGN, DEFIANCE, HARDIN, LOGAN, MERCER, PAULDING, PUTNAM, SHELBY, VAN WERT, and WILLIAMS COUNTIES

	Rates	Fringes
PAINTER		
Brush & Roller	$ 26.64	15.56
Drywall Finishing & Taping	$ 27.39	15.56
Lead Abatement	$ 28.39	15.56
Spray, Sandblasting Pressure Cleaning, & Refinery	$ 27.39	15.56
Swing Stage, Chair, Spiders, & Cherry Pickers	$ 26.89	15.56
Wallcoverings	$ 27.39	15.56

All surfaces 40 ft. or over where material is applied to or labor performed on, above ground level (exterior), floor level (interior) - $.50 premium

Applying Coal Tar Products - $1.00 premium

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* PAIN1275-002 11/01/2023

DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, MADISON, PICKAWAY, ROSS & UNION

	Rates	Fringes
PAINTER		
Bridges	$ 35.01	15.16
Brush; Roller	$ 29.40	15.16
Sandblasting; Steamcleaning; Waterblasting (3500 PSI or Over)& Hazardous Work	$ 30.10	15.16
Spray	$ 29.90	15.16
Stacks; Tanks; & Towers	$ 32.21	15.16
Structural Steel & Swing Stage	$ 28.25	15.16

PLAS0109-001 05/01/2023

MEDINA, PORTAGE, STARK, and SUMMIT COUNTIES

	Rates	Fringes
PLASTERER	$ 33.74	19.02

PLAS0109-003 05/01/2023

CARROLL, HOLMES, TUSCARAWAS, and WAYNE COUNTIES

	Rates	Fringes
PLASTERER	$ 33.74	19.02

PLAS0132-002 07/01/2023

BROWN, BUTLER, CLERMONT, HAMILTON, HIGHLAND, WARREN COUNTIES

	Rates	Fringes
PLASTERER	$ 28.40	16.24

PLAS0404-002 05/01/2018

ASHTABULA, CUYAHOGA, GEAUGA, AND LAKE COUNTIES

	Rates	Fringes
PLASTERER	$ 29.63	17.11

PLAS0404-003 05/01/2018

LORAIN COUNTY

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0526-022 05/01/2018

COLUMBIANA, MAHONING, and TRUMBULL COUNTIES

	Rates	Fringes
PLASTERER	$ 28.86	17.11

PLAS0526-023 05/01/2018

BELMONT, HARRISON, and JEFFERSON COUNTIES

	Rates	Fringes
PLASTERER	$ 28.21	17.11

PLAS0886-001 05/01/2023

FULTON, HANCOCK, HENRY, LUCAS, PUTNAM, and WOOD COUNTIES

	Rates	Fringes
PLASTERER	$ 33.74	18.95

PLAS0886-003 05/01/2023

DEFIANCE, ERIE, HURON, OTTAWA, PAULDING, SANDUSKY, and SENECA
COUNTIES

	Rates	Fringes
PLASTERER	$ 33.74	18.95

PLAS0886-004 05/01/2023

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, and VAN WERT COUNTIES

	Rates	Fringes
PLASTERER	$ 33.74	18.95

PLUM0042-002 07/01/2023

ASHLAND, CRAWFORD, ERIE, HURON, KNOX, LORAIN, MORROW, RICHLAND
& WYANDOT

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 37.62	25.47

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* PLUM0050-002 07/03/2023

DEFIANCE, FULTON, HANCOCK, HENRY, LUCAS, OTTAWA, PAULDING,
PUTNAM, SANDUSKY, SENECA, WILLIAMS & WOOD

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 47.15	30.21

PLUM0055-003 05/01/2023

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, MEDINA (N. of Rte. #18 &
Smith Road) & SUMMIT (N. of Rte. #303, including the corporate
limits of the city of Hudson)

	Rates	Fringes
PLUMBER	$ 41.11	29.88

PLUM0083-001 07/01/2017

BELMONT & MONROE (North of Rte. #78)

	Rates	Fringes
Plumber and Steamfitter	$ 32.16	31.51

PLUM0094-002 05/01/2023

CARROLL (Northen Half), STARK, and WAYNE COUNTIES

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 38.03	23.09

PLUM0120-002 05/01/2023

ASHTABULA, CUYAHOGA, GEAUGA, LAKE, LORAIN (the C.E.I. Power
House in Avon Lake), MEDINA (N. of Rte. #18) & SUMMIT (N. of
#303)

	Rates	Fringes
PIPEFITTER	$ 45.62	27.30

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* PLUM0162-002 06/01/2023

CHAMPAIGN, CLARK, CLINTON, DARKE, FAYETTE, GREENE, MIAMI,
MONTGOMERY & PREBLE

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 40.00	26.87

PLUM0168-002 06/01/2023

MEIGS, MONROE (South of Rte. #78), MORGAN (South of Rte. #78) & WASHINGTON

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 38.95	34.97

PLUM0189-002 06/01/2022

DELAWARE, FAIRFIELD, FRANKLIN, HOCKING, LICKING, MADISON, MARION, PERRY, PICKAWAY, ROSS & UNION

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 43.25	26.94

PLUM0219-002 06/01/2023

MEDINA (Rte. #18 from eastern edge of Medina Co., west to eastern corporate limits of the city of Medina, & on the county road from the west corporate limits of Medina running due west to and through community of Risley to the western edge of Medina County - All territory south of this line), PORTAGE, and SUMMIT (S. of Rte. #303) COUNTIES

	Rates	Fringes
Plumber and Steamfitter	$ 43.22	27.29

PLUM0392-002 06/01/2023

BROWN, BUTLER, CLERMONT, HAMILTON & WARREN

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 38.62	25.83

PLUM0396-001 06/01/2023

COLUMBIANA (Excluding Washington & Yellow Creek Townships & Liverpool Twp. - Secs. 35 & 36 - West of County Road #427), MAHONING and TRUMBULL COUNTIES

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 37.10	28.51

PLUM0495-002 06/01/2023

CARROLL (Rose, Monroe, Union, Lee, Orange, Perry & Loudon Townships), COLUMBIANA (Washington & Yellow Creek Townships & Liverpool Township, Secs. 35 & 36, West of County Rd. #427), COSHOCTON, GUERNSEY, HARRISON, HOLMES, JEFFERSON, MORGAN (South

to State Rte. #78 & from McConnelsville west on State Rte. #37
to the Perry County line), MUSKINGUM, NOBLE, and TUSCARAWAS
COUNTIES

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 32.23	35.40

PLUM0577-002 06/01/2023

ADAMS, ATHENS, GALLIA, HIGHLAND, JACKSON, LAWRENCE, PIKE,
SCIOTO & VINTON

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 39.98	26.48

PLUM0776-002 07/01/2023

ALLEN, AUGLAIZE, HARDIN, LOGAN, MERCER, SHELBY and VAN WERT
COUNTIES

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 40.07	28.95

TEAM0377-003 05/01/2023

STATEWIDE, EXCEPT CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 31.49	16.40
GROUP 2	$ 31.91	16.40

TRUCK DRIVER CLASSIFICATIONS

GROUP 1 - Asphalt Distributor; Batch; 4- Wheel Service; 4-Wheel Dump; Oil Distributor & Tandem

GROUP 2 - Tractor-Trailer Combination: Fuel; Pole Trailer; Ready Mix; Semi-Tractor; & Asphalt Oil Spraybar Man When Operated From Cab; 5 Axles & Over; Belly Dump; End Dump; Articulated Dump; Heavy Duty Equipment; Low Boy; & Truck Mechanic

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TEAM0436-002 05/01/2023

CUYAHOGA, GEAUGA & LAKE

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 31.00	18.95
GROUP 2	$ 32.50	18.95

GROUP 1: Straight & Dump, Straight Fuel

GROUP 2: Semi Fuel, Semi Tractor, Euclids, Darts, Tank, Asphalt Spreaders, Low Boys, Carry-All, Tourna-Rockers, Hi-Lifts, Extra Long Trailers, Semi-Pole Trailers, Double Hook-Up Tractor Trailers including Team Track & Railroad Siding, Semi-Tractor & Tri-Axle Trailer, Tandem Tractor & Tandem Trailer, Tag Along Trailer, Expandable Trailer or Towing Requiring Road Permits, Ready-Mix (Agitator or Non-Agitator), Bulk Concrete Driver, Dry Batch Truck, Articulated End Dump

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($17.20) or 13658 ($12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on
   a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION E

BID DOCUMENTS

Insert BID FORM here

COVER SHEET
BID BOND

Pursuant to the condition of the foregoing Notice to Bidders attached hereto is a Surety Company bond for the sum of_____

_____Dollars ($_____).

In case this proposal shall be accepted by the Owner and the undersigned shall fail to execute the contract and furnish a satisfactory bond as stated in the foregoing Notice to Bidders within (10) days (Sunday excepted) after notification of the award of the contract, then the said Owner may at its option determine that the undersigned has abandoned the contract and thereupon this proposal shall be null and void and the Surety bond accompanying same shall be forfeited to and become the property of the Owner as liquidated damages.

The full names and residences of all persons and parties interested in the foregoing bid as principals are as follows:

NAMES ADDRESSES

_____

_____

_____

_____

Name of Bidder_____

Business Address of Bidder _____

Dated at _____, the _____ day

of _____, 20 _____.

Proposal submitted by _____ _____
Signature Title

BID BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned _____

_____, as Principal and _____

_____, as Surety, are held and firmly bound unto the City of Wooster, Ohio, in the sum of _____

_____ Dollars ($_____) to be paid to the

said City of Wooster, Ohio, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, our successors, and assigns, executors and administrators jointly and severally, firmly by these presents.

The condition of this obligation is such that, if the proposal for _____

_____

is accepted, and the contract awarded to the above named bidder, and the bidder shall within (10) days after such award is made enter into a contract and give bond as required; then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Signed and sealed at _____, this _____ day

of _____, A.D., 20_____.

_____

_____
Principal

_____

_____
Surety

BID GUARANTY AND CONTRACT BOND

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

_____[1]

_____[2]

as Surety, are hereby held and firmly bound unto City of Wooster[3]
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:

The penal sum referred to herein shall be the dollar amount of the Principal's bid to the Obligee, incorporating any additive or deductive alternative 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 the alternatives 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 hereto between the amount specified in the bid and such larger amount for which the Obligee may in good faith contract with the next lower Bidder to perform the work covered by the bid; or in the event the Obligee does not award the contact to the next lower Bidder and resubmits the project for bidding, the Principal will pay the Obligee the difference, not to exceed ten percent of the penalty hereon 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 the Principal 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

[1]Here insert full name or legal title of Contractor and address
[2]Here insert full name or legal title of Surety
[3]Here insert full name or legal title of Owner

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 therefore shall in any way affect the obligations of said Surety on this bond, and it does hereby waive notice of any such modifications, omissions or additions to the term of the contract or to the work or to the specifications.

SIGNED AND SEALED This ___ day of _____, 20__.

_____

Principal

By: _____

Title: _____

_____

Surety

By: _____

Attorney-in-Fact

_____

Surety Company Address:

_____

_____

_____

Surety Agent's Name and Address:

_____

_____

SUBCONTRACTORS LIST
FOR
BIOSOLIDS UPGRADE PROJECT

In the spaces below, the Bidder shall list the names and addresses of any subcontractors to which the Bidder intends to sublet any portion of the work to be performed under this contract. The Bidder shall also state that portion of the work by bid item number and/or description that he intends to sublet to each subcontractor. No change of subcontractors or work to be performed by each subcontractor shall be made without prior written approval from the Engineer. Failure to complete this list may be grounds for rejection of the Bid.

Item No.	Subcontractor Name and Address
_____	_____
	_____
_____	_____
	_____
_____	_____
	_____
_____	_____
	_____
_____	_____

Bidder: _____

By: _____

Title: _____

Date: _____

CERTIFICATION/AFFIDAVIT IN COMPLIANCE WITH O.R.C. SECTION 3517.13

STATE OF _____

COUNTY OF _____, ss:

Personally appeared before me the undersigned, a bidder or representative of a bidder in competitive bidding on behalf of _____ for a contract
(Name)

for _____ to be let by _____ who, being
(Type of Product or Service) (Municipal Owner)

duly cautioned and sworn, makes the following statement with respect to prohibited activities constituting a conflict of interest or other violations under Section 3517.13 O.R.C., and further states that the undersigned has the authority to make the following representation on behalf of the entity if the undersigned as an individual is not the bidder himself or herself:

1. On behalf of the individual, partnership, other unincorporated business association, professional association organized under Chapter 1785 O.R.C. or estate or trust that all of the following persons, where applicable, are in compliance with 3517.13 (I)(1)1:

    a. the individual;
    b. each partner or owner of the partnership or other unincorporated business;
    c. each shareholder of the association;
    d. each administrator of the estate;
    e. each executor of the estate;
    f. each trustee of the trust;
    g. each spouse of any person identified in (a) through (f) of this section;
    h. each child seven years of age to seventeen years of age of any person identified in (a) through (f) of this section;
    i. any combination of persons identified in (a) through (f) of this section.

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1 O.R.C. § 3517.13 (I) (1) (a) provides: no agency or department of this state or any political subdivision shall award any contract for the purchase of goods costing more than five hundred dollars or services costing more than five hundred dollars to any individual, partnership or other unincorporated business, association, including, without limitation, a professional association organized under Chapter 1785 of the Revised Code, estate, or trust if *any person or entity* listed herein in paragraph 1, sub-paragraphs a-i above, *has made*, *as an individual*, within the two previous calendar years, *one or more contributions totaling in excess of one thousand dollars* to the holder of the public office having ultimate responsibility for the award of the contract or to the public officer's campaign committee.

2. On behalf of the individual, partnership, other unincorporated business association, professional association organized under Chapter 1785 O.R.C. or estate or trust that all of the following persons, where applicable, are in compliance with 3517.13 (I)(1) (b)2:

    a. the individual;
    b. each partner or owner of the partnership or other unincorporated business;
    c. each shareholder of the association;
    d. each administrator of the estate;
    e. each executor of the estate;
    f. each trustee of the trust;
    g. each spouse of any person identified in (a) through (f) of this section;
    h. each child seven years of age to seventeen years of age of any person identified in divisions (a) through (f) of this section;
    i. any political action committee affiliated with the partnership or other unincorporated business, association, estate, or trust.

3. On behalf of a corporation or business trust, except a professional association organized under Chapter 1785 O.R.C., that all of the following persons, where applicable, are in compliance with 3517.13 (J)(1)3:

    a. an owner of more than twenty per cent of the corporation or business trust;
    b. each spouse of an owner of more than twenty per cent of the corporation or business trust;
    c. each child seven years of age to seventeen years of age of an owner of more than twenty per cent of the corporation or business trust;
    d. any combination of persons identified in (a) through (c) of this section.

4. On behalf of a corporation or business trust, except a professional association organized under Chapter 1785 O.R.C., that all of the following persons, where applicable, are in compliance with 3517.13 (J)(2)4:

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2 O.R.C. § 3517.13 (I) (1) (b) provides: no agency or department of this state or any political subdivision shall award any contract for the purchase of goods costing more than five hundred dollars or services costing more than five hundred dollars to any individual, partnership or other unincorporated business, association, including, without limitation, a professional association organized under Chapter 1785 of the Revised Code, estate, or trust if *any combination of the person or entity* listed herein in paragraph 2, subparagraphs a-i above, *has made* within the two previous calendar years, *one or more contributions totaling in excess of two thousand dollars* to the holder of the public office having ultimate responsibility for the award of the contract or to the public officer's campaign committee.

3 O.R.C. § 3517.13 (J) (1) (a) provides: no agency or department of this state or any political subdivision shall award any contract for the purchase of goods costing more than five hundred dollars or services costing more than five hundred dollars to a corporation or business trust, except a professional association organized under Chapter 1785 of the Revised Code, *if any person listed herein in paragraph 3, sub-paragraphs a-d* has made, *as an individual*, within the two previous calendar years, taking into consideration only owners for all of that period, *one or more contributions totaling in excess of one thousand dollars* to the holder of the public office having ultimate responsibility for the award of the contract or to the public officer's campaign committee.

4 O.R.C. § 3517.13 (J) (1) (b) provides: no agency or department of this state or any political subdivision

a. an owner of more than twenty per cent of the corporation or business trust;
b. each spouse of an owner of more than twenty per cent of the corporation or business trust;
c. each child seven years of age to seventeen years of age of an owner of more than twenty per cent of the corporation or business trust;
d. any political action committee affiliated with the corporation or business trust.

BIDDER:

SIGNATURE: _____

NAME: _____

TITLE: _____

DATE: _____

Sworn to before me and subscribed in my presence by the above named person this ___ day of _____ _____, 20_____.

NOTARY PUBLIC: _____

My Commission Expires: _____

Eff. Apr. 4, 2007[Am. Sub.HB 694]

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shall award any contract for the purchase of goods costing more than five hundred dollars or services costing more than five hundred dollars to a corporation or business trust, except a professional association organized under Chapter 1785 of the Revised Code, *if any combination of the following has made*, within the two previous calendar years, taking into consideration only owners for all of that period, *one or more contributions totaling in excess of two thousand dollars* to the holder of the public office having ultimate responsibility for the award of the contract or to the public officer's campaign committee.

CITY OF WOOSTER
CONTRACTOR'S INFORMATION FORM

Project:

Contract: _____

By: _____ doing business as a ◯ Corporation,
(Contractor)

◯ Partnership, ◯ Sole proprietorship; for the following type of work:

_____	General Construction	_____	Site Work
_____	Demolition	_____	Utilities
_____	Road Construction	_____	Electrical
_____	Mechanical	_____	Other _____ (please specify)

1. BACKGROUND INFORMATION

1.1 Number of years in business as a Contractor: _____

1.2 If your organization is a corporation, answer the following:

1.2.1 Date of incorporation: _____
1.2.2 State of incorporation: _____
1.3.3 Officer's names and titles:
President: _____
Vice-President: _____
Secretary: _____
Treasurer: _____
Other authorized signor: _____

1.3 If your organization is a partnership, answer the following:

1.3.1 Date of organization: _____
1.3.2 Type of partnership (If applicable): _____
1.3.3 Name(s) of general partner(s):
_____
_____
_____

1.4 If your organization is individually owned, answer the following:

1.4.1 Date of organization: _____

1.4.2 Name of owner: _____

1.5 If the form of your organization is other than those listed above, describe it and name the principals:

_____

_____

_____

2. CONSTRUCTION QUALIFICATIONS

2.1 List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable. For construction trade licenses and/or registrations, list each type, license number and state of issuance.

_____

_____

_____

_____

_____

3. EXPERIENCE

3.1 List the categories of work that your organization normally performs with its own forces.

_____

_____

_____

_____

_____

3.2 Claims and Suits (If the answer to any of the questions below is yes, please attach details.)

3.2.1 Has your organization ever failed to complete any work awarded to it?
◯ YES ◯ NO

3.2.2 Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers?
◯ YES ◯ NO

3.2.3 Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years?
◯ YES ◯ NO

3.3 On a separate sheet, list major construction projects your organization has in progress, giving the name of project, owner, architect, engineer, contract

amount percent complete and scheduled completion date.

3.3.1 State total worth of work in progress and under contract.
_____

3.4 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, engineer, contract amount, date of completion and percentage of the cost of the work performed with your own forces.

3.4.1 State average annual amount of construction work performed during the past five years.
_____

3.5 On a separate sheet, list the construction experience and present commitments of the key individuals of your organization.

4. REFERENCES

4.1 Professional References: (List three (3) and include organization, contact name and phone number)

_____
_____
_____
_____
_____

5. CERTIFICATION

The undersigned, being duly sworn, certifies that the information provided herein is true and complete.

These facts are hereby acknowledged by _____ on this
(Organization)
_____ day of _____, 20___.

By: _____

Name and Title: _____

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

Notary Public: _____

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION F

AGREEMENT DOCUMENTS

AGREEMENT

This Agreement, made this _____ day of _____, 20_____,

_____ **Project**, in the amount of _____ dollars ($_____),by and between the City of Wooster, Ohio, hereinafter called the "City", acting herein through its Director of Administration and _____, doing business as (a corporation) (a partnership) (an individual) in the City of _____, County of _____, and State of _____, hereinafter called the "Contractor."

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The Contractor will furnish materials and services in accordance with the terms of the Contract Documents.

2. The following variations from the Contract Documents and or options have been agreed to:

_____

_____

3. The term "Contract Documents" means and includes the following:

a) Advertisement for Bids
b) Instruction to Bidders
c) Wage Rates
d) Payment and Performance Bond
e) Agreement Documents
f) Certifications
g) Miscellaneous Contract Forms
h) Partial Pays, Purchase Order
i) General Conditions
j) Supplemental Conditions
k) Construction and Material Specifications
l) Plans and Specifications
m) Addenda:

No. _____, dated _____, 20___.

No. _____, dated _____, 20___.

n) Any amendments to the above documents entered into by the City before or after award of Contract

4. City's engagement of the Contractor is based upon the Contractor's representations to the City that the Contractor:

a) has reviewed all documents pertinent to its portion or scope of the and has found them in all respects to be complete, accurate, adequate, consistent, coordinated and sufficient;
b) is an organization experienced in and qualified, willing and able to provide equipment of the nature and type necessary to perform its portion or scope of the Work
c) is authorized and licensed to do business in Ohio;
d) has the expertise and ability to meet the City's objectives and requirements.

5. The Contractor shall furnish services and labor which expeditiously, economically and properly complete its particular scope of the Work in the manner most consistent with the City's interests and objectives; in accordance with the Contract Documents, and in accordance with the highest standards currently practiced by persons and entities performing comparable labor and services on projects of similar size and complexity.

6. The Contractor expressly warrants and guarantees to the City that all goods, products, materials, equipment, and systems incorporated in its particular scope of the Work shall conform to applicable ; be new and without apparent damage; be of quality equal to or higher than that required by the Bid Documents; be merchantable ; and free from defects

7. The Contractor expressly warrants and guarantees to the City that all labor and services required for its particular scope of Work shall comply with the Bid Documents; be performed in a workmanlike manner; and be free from defects.

8. All warranties and guarantees set forth above shall be in addition to all other warranties, express, implied or statutory, and shall survive payment for, acceptance or inspection of, or failure to inspect the Work.

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

10. With respect to the intent and interpretation of this Contract, the City and the Contractor agree as follows:

(a) This Contract documents constitute the entire and exclusive agreements between the parties with reference to the Project, and said Contract supersedes any and all prior discussions, communications, representations, understandings, negotiations, or agreements.
(b) Anything that may be required, implied or inferred by the documents which make up this Contract, or any one or more of them, shall be provided by the Contractor for the Contract Price;
(c) Nothing contained in this Contract shall create, nor be interpreted to create, privity or any other relationship whatsoever between the City and any person except the Contractor;
(d) When a word, term, or phrase is used in this Contract, it shall be interpreted or construed first, as defined herein; second, if not defined, according to its generally accepted meaning in the construction industry; and third, if there is no generally accepted meaning in the construction industry, according to its common and customary usage;
(e) The words "include", "includes", or "including", as used in this Contract, shall be deemed to be followed by the phrase, "without limitation";
(f) The specification herein of any act, failure, refusal, omission, event, occurrence or condition as constituting a material breach of this Contract shall not imply that any other, non-specified act,

failure, refusal, omission, event, occurrence or condition shall be deemed not to constitute a material breach of this Contract;

11. The Contractor shall perform all of the work required, implied or reasonably inferable from this Contract including, but not limited to, the following:

(a) Construction of the Project;
(b) The furnishing of any required surety bonds and insurance;
(c) The provision or furnishing, and prompt payment therefor, of labor, supervision, services, materials, supplies, equipment, fixtures, appliances, facilities, tools, transportation, storage, power, fuel, heat, light, cooling, or other utilities, required for construction and all necessary building permits and other permits required for the construction of the Project;
(d) Neither payment to the Contractor, utilization of the Project for any purpose by the City, nor any other act or omission by the City shall be interpreted or construed as an acceptance of any work of the Contractor not strictly in compliance with this Contract;
(e) Prior to being entitled to receive final payment, and as a condition precedent thereto, the Contractor shall furnish the City, in the form and manner required by City:

(1) An affidavit that all of the Contractor's obligations to subcontractors, laborers, equipment or material suppliers, or other third parties in connection with the Project, have been paid or otherwise satisfied;
(2) If required by the City, separate releases of lien or lien waivers from each subcontractor, lower tier subcontractor, laborer, supplier or other person or entity who has, or might have a claim against the City or the City's property;
(3) If applicable, consent(s) of surety to final payment;
(4) All product warranties, operating manuals, instruction manuals and other record documents, drawings and things customarily required of the Contractor, or expressly required herein, as a part of or prior to Project closeout;

12. Termination by the Contractor

If the City repeatedly fails to perform its material obligations to the Contractor for a period of thirty (30) days after receiving written notice from the Contractor of its intent to terminate hereunder, the contractor may terminate performance under this Contract by written notice to the City and the Engineer. In such event, the Contractor shall be entitled to recover from the City as though the City had terminated the Contractor's performance under this Contract for convenience. At no time shall the City be liable for extra contractual, special, consequential, punitive or any other damages resulting from any cause including but not limited to loss of business, loss of business opportunity or any other damages not directly incurred by Contractor on the Project.

13. City's Right to Suspend Contractor's Performance

The City shall have the right at any time to direct the Contractor to suspend its performance, or any designated part thereof, for any reason whatsoever, or without reason, for a cumulative period of up to ten (10) calendar days. If any such suspension is directed by the City, the Contractor shall immediately comply with same.

In the event the City directs a suspension of performance under this Paragraph , through no fault of the Contractor, the City shall pay the Contractor as full compensation for such suspension the Contractor's reasonable costs, actually incurred and paid, of:

(a) demobilization and remobilization, including such costs paid to subcontractors;
(b) preserving and protecting work in place;
(c) storage of materials or equipment purchased for the Project, including insurance thereon;
(d) performing in a later, or during a longer, time frame than that contemplated by this Contract.

14. Termination by the City

The City may terminate this Contract in accordance with the following terms and conditions:

a) The City for any reason whatsoever, may terminate performance under this Contract by the Contractor for convenience. The City shall give written notice of such termination to the Contractor specifying when termination becomes effective. The Contractor shall incur no further obligations in connection with the work and the Contractor shall stop work when such termination becomes effective. Unless otherwise advised by the City, the Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders. The City may direct the Contractor to assign the Contractor's right, title and interest under termination orders or subcontracts to the City or its designee. The Contractor shall transfer title and deliver to the City such completed or partially completed work and materials, equipment, parts, fixtures, information and Contract rights as the Contractor has. When terminated for convenience, the Contractor shall be compensated as follows:

(1) The Contractor shall submit a termination claim to the City and the Engineer specifying the amounts due because of the termination for convenience together with costs, pricing or other data required by the City or the Engineer. If the Contractor fails to file a termination claim within one (1) year from the effective date of termination, the City shall pay the Contractor, an amount derived in accordance with Subparagraph (3) below;

(2) The City and the Contractor may agree to the compensation, if any, due to the Contractor hereunder;

(3) Absent agreement to the amount due to the Contractor, the City shall pay the Contractor the following amounts:

(i) Contract prices for labor, materials, equipment and other services accepted under this Contract;
(ii) Reasonable costs incurred in preparing to perform and in performing the terminated portion of the work, and in terminating the Contractor's performance, plus a fair and reasonable allowance for direct jobsite overhead and profit thereon (such profit shall not include anticipated profit or nonsequential damages); provided however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract would have been completed,

no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss, if any;

(iii) Reasonable costs of settling and paying claims arising out of the termination of subcontracts or orders pursuant to Subparagraph (A) of this Paragraph. These costs shall not include amounts paid in accordance with other provisions hereof.

The total sum to be paid the Contractor shall not exceed the total Contract Price, as properly adjusted, reduced by the amount of payments otherwise made, and shall in no event include duplication of payment.

(b) If the Contractor does not perform the work, or. any part thereof, in a timely manner, supply adequate labor, supervisory personnel or proper equipment or materials, or if it fails to timely discharge its obligations for labor, equipment and materials, or proceeds to disobey applicable law, or otherwise commits a violation of a material provision of this Contract, then the City, in addition to any other rights it may have against the Contractor or others, may terminate the performance of the Contractor and assume possession of the Project site and of all materials and equipment at the site and may complete the work. In such case, the Contractor shall not be paid further until the work is complete. After final completion has been achieved, if any portion of the Contract Price, as it may be modified hereunder, remains after the cost to the City of completing the work, including all costs and expenses of every nature incurred, has been deducted by the City, such remainder shall belong to the Contractor. Otherwise, the Contractor shall pay and make whole the City for such cost. This obligation for payment shall survive the termination of the Contract.

In the event the employment of the Contractor is terminated by the City for cause pursuant to this Subparagraph and it is subsequently determined by a Court of competent jurisdiction that such termination was without cause, such termination shall thereupon be deemed a Termination for Convenience under Subparagraph A) and the provisions of Subparagraph (A) shall apply.

15. Dispute Resolution.

Any and all disputes concerning this Agreement, the performance of work, and/or any other contract documents including but not limited to requests for additional compensation or extension of the contract completion date shall be resolved as follows and as set forth in Section 10 of the General Conditions:

(a) Notice of a claim or request shall be submitted to the City Director of Administration and City Engineer within seven (7) calendar days after the initial acts giving rise to the claim. At such time, the Contractor shall provide all information including costs or anticipated costs or time extensions. If the costs or time extension is not currently known, Contractor shall note same and shall provide updates every thirty (30) days until the claim is fully ready for analysis and consideration by the City. In connection with the claim submission, Contractor shall also provide supporting documents and proof for its claim or request for extension of time.

(b) The City shall have up to forty-five (45) days to consider and determine any and all such claims or requests for extension of time, after it has been fully submitted. Contractor shall take no further action in connection with the claim or request until either the City has issued a decision or forty-five (45) days has passed. During the pendency of such claim, Contractor shall continue to fully perform on the Project unless otherwise advised by City.

(c) The City shall issue a written decision within forty-five (45) days, of receipt of the complete claim or request from the Contractor.

(d) If Contractor is not satisfied with the City's determination, it has the final option to file legal proceedings with the appropriate court within Wayne County, Ohio. Contractor shall not proceed to litigation in Wayne County court until and unless it has exhausted all administrative remedies as set forth herein.

16. Applicable Law.

This Agreement shall be construed and interpreted in accordance with the laws of the State of Ohio.

17. Amendments.

Any amendments to this Agreement and/or any other contract document must be writing entered into by the Contractor and City in accordance with the City's provisions for entering into contracts. No amendment to this Agreement and any other contract documents shall be valid unless it is in writing signed by both parties.

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

CITY OF WOOSTER, OHIO

ATTEST:

By: _____
Joel Montgomery, P.E.
Director of Administration

_____

ATTEST:

Contractor: _____

_____

By: _____

Title: _____

Address: _____

_____

Phone: _____

LEGAL OFFICER'S CERTIFICATE

Project Identification: _____

The foregoing Agreement between the City of Wooster, Ohio, (City) and

_____ (Contractor) is approved as to form.

_____ _____

Date John A. Scavelli, Director of Law

DELINQUENT PERSONAL PROPERTY TAX AFFIDAVIT

STATE OF _____

COUNTY OF _____

BID IDENTIFICATION

The undersigned, being first duly sworn, having been awarded a contract by the City of Wooster, Wayne County, Ohio for

_____

_____

hereby affirms, pursuant to Section 5719.042 of the Ohio Revised Code that, at the time the Bid was submitted the company **(was) (was not)** charged with delinquent personal property taxes of the General Tax List of Personal Property for Wayne County, Ohio.

If such charge for delinquent personal property taxes exists on the General Tax List of Personal Property for Wayne County, Ohio, the amount of such due and unpaid delinquent taxes, including due and unpaid penalties shall be set forth below.

A copy of this statement shall be transmitted by the Fiscal Officer to the County Treasurer within thirty (30) days of the date it is submitted.

Delinquent Personal Property Tax: $_____

Penalties: $_____

Interest: $_____

Signed:

_____ _____

Name Title

Subscribed and sworn to before me this _____ day of _____, 20___.

NOTARY SEAL

_____

Notary Public

CONTRACT BOND

KNOW ALL MEN BY THESE PRESENT, that we, the undersigned, _____

_____

as principal and _____

as sureties, are hereby held and firmly bound unto the City of Wooster, Ohio, in the penal sum of _____ Dollars

for payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this _____ day of _____, 20_____.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, THAT, whereas the above

named principal did on the _____ day of _____, 20_____, enter into a contract with the City of Wooster, Ohio, which said contract is made a part of the bond and the same as though set forth herein;

Now, if the said principal shall well and faithfully do the things agreed by him (it) to be done and performed according to the term of said contract, and shall pay all lawful claims of sub-contractors, material-men and laborers, for labor performed and material furnished in the carrying forward, performing or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any material man 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 the said contract or in or to the plans or specifications therefore shall in any wise effect the obligations of said surety on its bond.

WITNESS:

_____ _____

_____ _____

Principal

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION G

CERTIFICATIONS

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION H

MISCELLANEOUS CONTRACT FORMS

NOTICE OF AWARD

To: _____

The City of Wooster, Ohio, having considered the Bid submitted by you for WRRF DIGESTER IMPROVEMENTS in response to the Advertisement for Bids dated _____and in the amount of $_____ does hereby notify you that your bid has been accepted.

The following variations from the Specifications and Bid Instructions have been allowed:

_____

_____

Delivery shall be on or before the period established in the bidding documents.

You are required to execute the Agreement within ten (10) calendar days from the date of this Notice to you. If you fail to execute said Agreement within ten (10) calendar days of the date of this Notice, the City of Wooster will be entitled to consider all of its rights arising out of the City's acceptance of your Bid as abandoned and as a forfeiture of your Bid Bond. The City of Wooster will also be entitled to such other rights as may be granted by law.

City of Wooster, Ohio

By: _____ Date: _____
Joel Montgomery, P.E.
Director of Administration

Acceptance of Notice of Award

Receipt of the above Notice of Award is hereby acknowledged by

_____ this _____day of _____, 20___.

By: _____

Name: _____

Title: _____

NOTICE TO PROCEED

To: _____ Date: _____

Project: _____

You are hereby to commence WORK in accordance with the Agreement dated _____, 20_____, on or before _____, 20_____, and you are to complete the WORK within _____ consecutive calendar days thereafter.

The date of completion of all WORK is therefore _____, 20_____.

Owner: City of Wooster

_____
Joel Montgomery, P.E.
Director of Administration

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

by _____,

on this _____ day of _____, 20_____.

By: _____

Name & Title: _____

NOTICE OF COMMENCEMENT OF A PUBLIC IMPROVEMENT PURSUANT TO REVISED CODE §1311.252

State of Ohio)
) ss:
County of Wayne)

Joel Montgomery, P.E. (the "Affiant"), being first duly sworn, says that:

1. Affiant is the Director of Administration of the City of Wooster, 538 N. Market St., P.O. Box 1128, Wooster, Ohio 44691-7082 (the "Public Authority").

2. The Public Authority will be commencing a public improvement identified as follows: (name, location, and any number)

.

3. The following lists the name, address and trade of each of the principal contractors working on this public improvement:

NAME	ADDRESS	TRADE	DATE OF FIRST EXECUTE CONTRACT FOR THE PUBLIC IMPROVEMENT

4. The following lists the names and addresses of the sureties for all of those principal contractors:

PRINCIPAL CONTRACTOR	NAME OF SURETY	ADDRESS OF SURETY

5. For the purpose of serving an affidavit pursuant to Revised Code 1311.26, service may be made upon the following representative of the Public Authority: Joel Montgomery, P.E., Director of Administration, at 538 N. Market St., P.O. Box 1128, Wooster, Ohio 44691-7082.

FURTHER AFFIANT SAYETH NAUGHT.

_____
Joel Montgomery, P.E.,
Director of Administration

SWORN TO before me and subscribed in my presence this _____ day of _____, 20__.

_____
[SEAL] Notary Public

MAINTENANCE AND GUARANTEE BOND

(Project name)

KNOW ALL BY THESE PRESENTS, that _____, as Principal, and _____ as Surety, are held and firmly bound unto the City of Wooster as Owner, in the sum of _____ Dollars ($_____), good and lawful money of the United States of America, to be paid to said Owner, its legal representatives and assigns, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, and each and every one of them jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the ___ day of _____, 20___ for construction of _____ (hereinafter called the Contract) which Contract, including Specifications, shall be deemed a part hereof as fully as if set out herein.

NOW, THEREFORE, the condition of this obligation is such that if Principal shall faithfully carry out and perform the warranty requirements of the Contract, and shall, on due notice, repair and make good at its own expense any and all defects in materials or workmanship in the said work which may develop during the two year period following substantial completion of the Contract, or shall pay over, make good and reimburse to the Owner all loss and damage which Owner may sustain by reason of failure or default of Principal so to do, then this obligation shall be null and void; otherwise to remain in full force and effect.

This warranty shall be in effect from the ___ day of _____, 20___ through the _____ day of _____, 20___

The responsibilities of the CONTRACTOR for operation, safety, maintenance, utilities, insurance and warranties and guarantees shall include: All contract items _____

PROVIDED, that Owner shall provide 30 days' notice and opportunity to cure to the Surety before commencing repairs to any defects in materials or workmanship in the said work. However, the Owner may make immediately those repairs which it reasonably determines to be necessary to protect life, limb and/or property.

No claim, suit, or action by reason of any default of the Principal shall be brought hereunder after the expiration of one year from the end of the maintenance period as herein set forth.

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed by their respective authorized officers this ___ day of _____, 20___.

WITNESS _____

_____ By: _____

WITNESS _____

_____ By: _____

Attorney-in-Fact

I hereby approve the form and correctness of the foregoing bond.

_____

Owner's Legal Counsel

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT _____

DATE OF ISSUANCE _____

OWNER CITY OF WOOSTER, OHIO

PROJECT NO. _____

CONTRACTOR _____

ENGINEER DIVISION OF ENGINEERING

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof.

TO CITY OF WOOSTER, OHIO
OWNER

And To _____
CONTRACTOR

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within ____days of the above date of Substantial Completion.

EJCDC No. 1910-8-D (1990 Edition)
Prepared by the Engineers Joint Contract Documents Committee and endorsed by The Associated General Contractors of America.

From the date of Substantial Completion the responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees shall be as follows:

RESPONSIBILITIES

OWNER: _____

CONTRACTOR: _____

The following documents are attached to and made a part of this Certificate:

[For items to be attached see definition of Substantial Completion as supplemented and other specifically noted conditions precedent to achieving Substantial Completion as required by Contract Documents.]

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

CONTRACTOR accepts this Certificate of Substantial Completion on _____, 20___

_____
CONTRACTOR

By: _____
(Authorized Signature)

OWNER accepts this Certificate of Substantial Completion on _____, 20____

CITY OF WOOSTER – DIVISION OF ENGINEERING
OWNER

By: _____
(Authorized Signature)

+ + END OF CERTIFICATE OF SUBSTANTIAL COMPLETION + +

Insert Partial Payment Form Here

CHANGE ORDER

No.

PROJECT:

DATE OF ISSUANCE: EFFECTIVE DATE:

OWNER: CITY OF WOOSTER

ENGINEER: DIVISION OF ENGINEERING

CONTRACTOR:

You are directed to make the following changes in the Contract Documents.

Description:

Reason for Change Order:

CHANGE IN CONTRACT PRICE: Original Contract Price $	CHANGE IN CONTRACT COMPLETION DATE: Original Contract Final Completion Date:
Net changes from previous Change Order No. ____ to No. ____ $	Net changes from previous Change Orders Days:
Contract Price prior to this Change Order $	Completion Dates prior to this Change Order: Contract Final Completion Date:
Net Increase of this Change Order $	Net Time Extension of this Change Order: Days:
Contract Price with all approved Change Orders $	Contract Completion Dates with all Approved Change Orders: Revised Contract Final Completion Date:

APPROVED:

By: _____

Date: _____

ACCEPTED:

By: _____

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 and Location)

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

are in compliance with the 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 or 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.

CONTRACTORS AFFIDAVIT

Waiver of Liens / Attested Accounts

STATE OF _____)
) ss
County of _____)

The undersigned, _____

hereby represents that on _____ he (it) was awarded a contract by the City of Wooster, Ohio hereinafter called the Owner, for the installation or construction of

in accordance with the terms and condition of the Contract ; and the undersigned further represents that the subject work for which payment is requested under the said contract has now been completed.

The undersigned hereby warrants and certifies that all of his (its) indebtedness arising by reason of the said contract has been fully paid or satisfactorily secured; and that all claims from sub-contractors and others for labor and material used in accomplishing the said project, as well as all other claims arising from the performance of the said contract, have been fully paid or satisfactorily settled. The undersigned further agrees that, if any such claim should hereafter arise, he (it) shall assume responsibility for the same immediately upon request to do so by the Owner.

The undersigned, for valuable consideration, the receipt of which is hereby acknowledged, does further hereby waive, release and relinquish any and all claims or right of lien and/or attested accounts which the undersigned now has or may hereafter acquire upon the subject premises for labor and material used in accomplishing said project owned by the Owner.

This affidavit is freely and voluntarily given with full knowledge of the facts, on this _____ day of _____, A.D. 20__.

_____
Contractor

By _____

Title _____

Subscribed and sworn to before me this _____ day of _____,

in the year of our Lord, 20_____.

(Seal) _____
Notary Public

_____
My Commission Expires

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS UPGRADE PROJECT

SECTION I

GENERAL CONDITIONS

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General Conditions

GENERAL CONDITIONS

1. GUARANTEE AND WARRANTY

The Contractor shall guarantee and warrant all equipment for two (2) years from the date of the completion of the installation. All faulty installations shall be repaired within the warranty period by the contractor at no expense to the City.

2. PAYMENTS

The contractor shall prepare and present to the City a Payment Request. Payment Requests may be submitted at anytime but not more often than once per month.

Said Payment Request shall be in such format and shall include supporting information as may be required by the City. Payment Requests may include request for payment of labor and materials properly incorporated in the Project, and materials or equipment necessary for the Project and properly stored at the Project site less the total amount of previous payments received from the City. Any payment on account of stored materials will be subject to the Contractor providing written proof that the City has title to such materials. Each such Payment Request shall be signed by the Contractor and shall constitute the Contractor's representation that the quantity of work has reached the level for which payment is requested, that the work has been properly installed or performed in strict compliance with this Contract, all other contract documents and that the Contractor knows of no reason why payment should not be made as requested. Thereafter, the Director shall review the Payment Request and may also review the work at the Project site or elsewhere to determine whether the quantity and quality of the work is as represented in the Payment Request and is as required by this Contract.

The amount of each such payment shall be the amount approved for payment by the Director less retainage of 8% for the first 50% of work completed and less such amounts, if any, otherwise owing by the Contractor to the City or which the City shall have the right to withhold as authorized by this Contract. The Administrator's approval of the Contractor's Payment Requests shall not preclude the City from the exercise of any of its rights. The submission by the Contractor of a Payment Request also constitutes an affirmative representation and warranty that all work for which the City has previously paid is free and clear of any lien, claim, or other encumbrance of any person whatsoever. As a condition precedent to payment, the Contractor shall, if required by the City, also furnish to the City properly executed waivers of lien or attested accounts, in a form acceptable to the City, from all subcontractors, materialmen, suppliers or others having lien or attested account rights, wherein said subcontractors, materialmen, suppliers or others having lien or attested account rights, shall acknowledge receipt of all sums due pursuant to all prior Payment Requests and waive and relinquish any liens, lien rights, attested accounts, attested account rights, or other claims relating to the Project. Furthermore, the Contractor warrants and represents that, upon payment of the Payment Request submitted, title to all work included in such payment shall be vested in the City.

The unit price, as bid, shall be full compensation for all work performed according to these specifications.

The City shall have the right to refuse to make payment and, if necessary, may demand the return of a portion or all of the amount previously paid to the Contractor due to:

(a) The quality of a portion, or all, of the Contractor's work not being in accordance with the requirements of this Contract and all other contract documents;
(b) The quantity of the Contractor's work not being as represented in the Contractor's Payment Request, or otherwise;
(c) The Contractor's rate of progress being such that, in the City's opinion, substantial or final completion, or both, may be inexcusably delayed;
(d) The Contractor's failure to use Contract funds, previously paid the Contractor by the City, to pay Contractor's Project-related obligations including, but not limited to, subcontractors, laborers and material and equipment suppliers;

(e) Claims made, or likely to be made, against the City or its property;
(f) Losses caused by the Contractor's failure or refusal to perform any of its obligations to the City;

In the event that the City makes written demand upon the Contractor for amounts previously paid by the City as contemplated in this Subparagraph 2, the Contractor shall promptly comply with such demand.

In the event the City becomes informed that the Contractor has not paid a subcontractor, materialman, laborer, or supplier as provided herein, the City shall have the right, but not the duty, to issue future checks and payment to the Contractor of amounts otherwise due hereunder naming the Contractor and any such subcontractor, materialman, laborer, or supplier as joint payees. Such joint check procedure, if employed by the City, shall create no rights in favor of any person or entity beyond the right of the named payees to payment of the check and shall not be deemed to commit the City to repeat the procedure in the future.

Neither payment to the Contractor, utilization of the Project for any purpose by the City, nor any other act or omission by the City shall be interpreted or construed as an acceptance of any work of the Contractor not strictly in compliance with this Contract, and all contract documents.

3. BONDS AND INSURANCE

3.1 Performance and Other Bonds:

Contractor shall furnish performance and payment bonds in an amount equal to One Hundred Percent (100%) of the contract award amount as security for the faithful performance and payment of all Contractor's obligations under Contract Documents. These Bonds shall remain in effect at least until two years after the date when final payment is made, except as otherwise provided by Law or Regulation or by the Contract Documents. Contractor shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and 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 Audit Staff Bureau of Accounts, U.S. Treasury Department and as authorized to issue surety bonds in the State of Ohio by the Superintendent of the Ohio Department of Insurance. All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.

If the surety of any Bond furnished by Contractor is declared a bankrupt or becomes insolvent or its rights 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 3.1 Contractor shall within five days thereafter substitute another Bond and Surety, both of which must be acceptable to City.

3.2 Bid Bonds

Bid security shall be in an amount not less than ten percent (10%) of the total amount bid. All bonds shall meet the requirements of O.R.C. Section 153.571, and as specified in these Contract Documents. Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and as authorized to issue surety bonds in the State of Ohio by the Superintendent of the Ohio Department of Insurance.

The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, City may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom City believes to have a reasonable chance of receiving the award may be retained by City until the earlier of the seventh day after the Effective Date of the Agreement or the sixty-first day after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within seven days after the Bid opening. Others will be returned after successful award to a bidder.

4. INSURANCE

4.1 Contractor's Liability Insurance:

Contractor shall purchase and maintain such Commercial General Liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance and furnishing of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed or furnished by Contractor, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

Claims under worker's disability benefits and other similar employee benefit acts, damages because of bodily injury, occupational sickness, disease, or death of Contractor's employees;

Claims for damages because of bodily injury, property damage, personal injury ,sickness or disease, or death of any person other than Contractor's employees 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;

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

Claims arising out of operation of Laws and Regulations for damages because of bodily injury or death of any person or for damage to property.

The insurance required by this Section shall include the specific overages and be written with limits of liability not less than One Million Dollars ($1,000,000 each occurrence). The Commercial General Liability insurance shall include completed operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty (30) days' prior written notice has been given to City by certified mail and shall contain an endorsement naming City of Wooster as Additional Insured with respect to Contractor’s work performed pursuant to this agreement. All such insurance shall remain in effect during the term of the contract.

The risk of loss within the deductible amount will be borne by Contractor, Subcontractor 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.

4.2 Contractual Liability Insurance:

The Commercial General Liability insurance required will include contractual liability insurance applicable to Contractor's obligations.

4.3 City's Liability Insurance:

City shall be responsible for purchasing and maintaining City's own liability insurance and, at City's option, may purchase and maintain such insurance as will protect City against claims which may arise from operations under the Contract Documents.

City shall not be responsible for purchasing and maintaining any property insurance to protect the interests of Contractor, Subcontractors or others in the Work.

4.4 Builder’s Risk Insurance:

City may obtain and maintain builder’s risk property insurance during the project in a form acceptable to it for the full

costs of replacement at the time of any loss as set forth herein. This insurance shall include as additional insureds, the Contractor, Subcontractors and material suppliers working on the Project. This insurance shall include all risk insurance for physical loss for damage including without duplication of coverage at least theft, vandalism, malicious mischief, flood, earthquake, tornado, Acts of God and other related matters. Owner may increase the limits of coverage if necessary to reflect estimated replacement costs. This insurance shall be written without a co-insurance clause. Owner shall be solely responsible for any deductible amounts.

4.5 Waiver of Rights:

City and Contractor waive all rights against each other for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to requirements herein and any other property insurance applicable to the Work, and also waive all such rights against the Subcontractors, and all other parties named as insureds in such policies for losses and damages so caused. Each subcontract between Contractor and a Subcontractor will contain similar waiver provisions by the Subcontractor in favor of City, Contractor, and all other parties named as insureds. None of the above waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by City as trustee or otherwise payable under any policy so issued.

City and Contractor intend that any policies provided in response to requirements herein shall protect all of the parties insured and provide primary coverage for all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds, and if the insurers require separate waiver forms to be signed by any Subcontractor, Contractor will obtain the same.

4.6 Receipts and Application of Proceeds:

Any insured loss under the policies of insurance required herein will be adjusted with City and made payable to City as trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. City 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 or Written Amendment.

City as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to City's exercise of this power. If such objection be made, City as trustee shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If required in writing by any party in interest, City as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of such duties.

4.7 Acceptance of Insurance:

If City has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by Contractor on the basis of its not complying with the Contract Documents, City shall notify Contractor in writing thereof within ten days of the date of delivery of such certificates to City. If Contractor has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by City on the basis of their not complying with the Contract Documents, Contractor shall notify City in writing thereof within ten days of the date of delivery of such certificates to Contractor. City and Contractor shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request. Failure by City or Contractor to give any such notice of objection within the time provided shall constitute acceptance of such insurance purchased by the other as complying with the Contract Documents.

5. ESTIMATED QUANTITIES

The Contractor agrees that the estimated quantities are only for the purpose of comparing the bids offered for the work under this Contract, and further agrees that he will make no claim for anticipated profits or loss of profits because of a difference between the quantities of the various classes of work actually furnished and the said estimated quantities; and he agrees that the City shall not be held responsible if, in the construction of the work, any of the said estimated quantities should be found to vary from the quantities shown, and that the City may, without alteration or modification of this Contract, increase, decrease, or omit the amount of any class or portion of the work as may be deemed necessary.

6. TIME OF COMPLETION AND LIQUIDATED DAMAGES

It is anticipated that a "Notice to Proceed" will be issued within ten days of execution of the Contract Agreement. All work shall be complete by the date designated on the Notice To Proceed.

The Contractor shall diligently continue its performance to and until final completion of the Project. The Contractor shall accomplish Substantial Completion of the Project by the above specified date.

The Contractor shall pay the City the sum of One Thousand Seven Hundred Fifty Dollars ($1,750.00) per day for each and every calendar day of unexcused delay in achieving Substantial Completion beyond the date set forth herein for Substantial Completion. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by the City, estimated at the time of executing this Contract. When the City reasonably believes that Substantial Completion will be inexcusably delayed, the City shall be entitled, but not required, to withhold from any amounts otherwise due the Contractor an amount then believed by the City to be adequate to recover liquidated damages applicable to such delays.

The Contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following, and the Contractor has promptly given written notice of such delay to the City:

a) To any preference, priority or allocation order duly issued by the City;

b) To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, or of the public enemy, acts of the City, acts of another Contractor in the performance of a contract with the City, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

c) To any delays of Subcontractors occasioned by any of the causes specified in paragraphs a) and b) of this article.

When Substantial Completion has been achieved, the Contractor shall notify the City in writing and shall furnish to the Engineer a listing of those matters yet to be finished. The Director or his designee will thereupon conduct an inspection to confirm that the work is in fact substantially complete. Upon its confirmation that the Contractor's work is substantially complete, the Director will so notify the City and Contractor in writing and will therein set forth the date of Substantial Completion. Guarantees and equipment warranties required by this Contract shall commence on the date of Substantial Completion. Upon Substantial Completion, and the tender of all closeout documents from Contractor to City including if applicable waivers of liens or attested accounts, operation and maintenance manuals, written guarantees and other necessary documents, the City shall pay the Contractor an amount sufficient to increase total payments to the Contractor to one hundred percent (100%) of the Contract Price less any amounts attributable to liquidated damages, together with the reasonable costs as determined by the City for completing all incomplete work, correcting and bringing into conformance all defective and nonconforming work, and handling any outstanding or threatened claims.

If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the City has withheld payment, the City shall promptly release to the Contractor those funds withheld, but no longer

applicable, as liquidated damages.

The term "Substantial Completion", as used herein, shall mean that point at which, as certified in writing by the Engineer, the Project is at a level of completion in strict compliance with this Contract such that the City or its designee can enjoy beneficial use or occupancy and can use or operate it in all respects, for its intended purpose. Partial use or occupancy of the Project shall not result in the Project being deemed substantially complete, and such partial use or occupancy shall not be evidence of Substantial Completion;

All limitations of time set forth herein are material and are of the essence of this Contract.

7. FINAL COMPLETION

When the Project is finally complete it shall notify the City in writing. Thereupon, the Director will perform a final inspection of the Project. If the Director confirms that the Project is complete in full accordance with this Contract and that the Contractor has performed all of its obligations to the City hereunder, the Director will furnish a final Approval for Payment to the City certifying to the City that the Project is complete and the Contractor is entitled to the remainder of the unpaid Contract Price, less any amount withheld pursuant to this Contract. Prior to completion, Contractor shall deliver to City two sets of as-built documents making all necessary modifications to the plans and specifications to reflect as-built conditions of the Project

8. CEASE AND DESIST ORDER

In the event the Contractor fails or refuses to perform the work as required herein, the City may instruct the Contractor to cease and desist from performing further work in whole or in part. Upon receipt of such instruction, the Contractor shall immediately cease and desist as instructed by the City and shall not proceed further until the cause for the City's instructions has been corrected, no longer exists, or the City instructs that the work may resume. In the event the City issues such instructions to cease and desist, and in the further event that the Contractor fails and refuses within seven (7) days of receipt of same to provide adequate assurance to the City that the cause of such instructions will be eliminated or corrected, then the City shall have the right, but not the obligation, to carry out the work with its own forces, or with the forces of another contractor, and the Contractor shall be fully responsible and liable for the costs of performing such work by the City. The rights set forth herein are in addition to, and without prejudice to, any other rights or remedies the City may have against the Contractor.

9. DUTIES, OBLIGATIONS AND RESPONSIBILITIES OF THE CONTRACTOR

If the Contractor performs work knowing or believing it involves an error, inconsistency or omission in the Contract without first providing written notice to the City, the Contractor shall be responsible for such work and pay the cost of correcting same;

All work shall strictly conform to the requirements of this Contract; the work shall be strictly supervised, the Contractor bearing full responsibility for any and all acts or omissions of those engaged in the work on behalf of the Contractor;

The Contractor warrants that all labor furnished under this Contract shall be competent to perform the tasks undertaken, that the product of such labor shall yield only first-class results, that all materials shall be new and of high quality, that the completed work will be complete, of high quality, without defects, and that all work strictly complies with the requirements of this Contract and the contract documents. Any work not strictly complying with the requirements of this Subparagraph shall constitute a breach of the Contractor's warranty;

The Contractor shall obtain and pay for all required permits, fees and licenses. The Contractor shall comply with all legal requirements applicable to the work;

The Contractor shall employ and maintain at the Project site only competent supervisory personnel. The Contractor shall give written notice to the City of key supervisory personnel assigned by the Contractor to this Project, and shall not

change them without notice to the City and approval by the City.

The Contractor shall maintain the Project site in a reasonably clean condition during performance of the work.

The Contractor will supervise and direct the work and shall be solely responsible for the means, methods, techniques, sequences and procedures of construction.

The Contractor agrees that none of its employees, agents, contractors or subcontractors will hold themselves out as, or claim to be, agents, officers or employees of The City of Wooster, and will not, by reason of any relationship with The City of Wooster, make any claim, demand or application to or for any right or privilege applicable to an agent, officer or employee of the City, including but not limited to, rights and privileges concerning worker's compensation and occupational diseases coverage, unemployment compensation benefits, social security coverage or retirement membership or credit.

10. CLAIMS BY THE CONTRACTOR

Claims by the Contractor against the City are subject to the following terms and conditions and as outlined in Section 15, Dispute Resolution, of the Agreement:

(a) All Contractor claims against the City shall be initiated by a written claim submitted to the City. Such claim shall be received by the City no later than seven (7) calendar days after the event, or the first appearance of the circumstances, causing the claim, and same shall set forth in detail all known facts and circumstances supporting the claim;

(b) The Contractor and the City shall continue their performance hereunder regardless of the existence of any claims submitted by the Contractor;

(c) In connection with any claim by the Contractor against the City for compensation in excess of the Contract Price, any liability of the City for the Contractor's cost shall be strictly limited to direct costs incurred by the Contractor and shall in no event include indirect cost or consequential damages of the Contractor;

(d) In the event the Contractor should be delayed in performing any task which at the time of the delay is then critical, or which during the delay becomes critical, as the sole result of any act or omission by the City or someone acting in the City's behalf, or by City-authorized Change Orders, fire or other Acts of God, the date for achieving Substantial Completion, or, as applicable, final completion, shall be appropriately adjusted by the City upon the written claim of the Contractor to the City and the Engineer. A task is critical within the meaning of this Subparagraph if, and only if, said task is on the critical path of the Project schedule so that a delay in performing such task will delay the ultimate completion of the Project. Any claim for an extension of time by the Contractor shall strictly comply with the requirements herein. If the Contractor fails to make such claim as required in this Subparagraph, any claim for an extension of time shall be waived.

11. TAXES

The Contractor will pay all sales, consumer, use and other similar taxes required by law unless otherwise exempt from doing so.

12. CHANGE ORDERS AND CHANGES TO WORK

The City may at any time, as the need arises, order changes within the scope of the work without invalidating the Contract. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the WORK, an equitable adjustment shall be authorized by Change Order..

The City Project Manager, also, may at any time, by issuing a Field Order, make changes in the details of the work. The Contractor shall proceed with the performance of any changes in the work so ordered by the City unless the Contractor believes that such Field Order entitles him to a change in Contract Price or time, or both, in which event he shall give the City Project Manager written notice thereof within seven (7) days after the receipt of the ordered change. Thereafter

the Contractor shall document the basis for the change in Contract Price or time within thirty (30) days. The Contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the Owner..

The value of any work covered by a Change Order or of any claim for increase or decrease in the Contract Price shall be determined by one or more of the following methods in the order of precedence listed below:

(a) Unit prices previously approved

(b) An agreed lump sum price including but not to exceed fifteen percent (15%) for general Overhead and profit.

(c) The actual cost for labor, direct overhead, materials, supplies, equipment and other services necessary to complete the work. In addition there shall be added an amount to be agreed upon but not to exceed fifteen percent (15%) of the actual cost of the WORK to cover the cost of general overhead and profit.

13. CORRECTION OF WORK

The Contractor shall promptly remove from the premises all work rejected by the City for failure to comply with the Contract Documents, whether incorporated in the construction or not, and the Contractor shall promptly replace and re-execute the work in accordance with the Contract Documents and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

All removal and replacement WORK shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of written Notice, the Owner may remove such work and store materials and all such removal and storage costs shall be at the expense of the Contractor.

14. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the Contract Documents or the Performance Bond and Payment Bonds.

15. AFFIRMATIVE ACTION

The Contractor commits itself to the goals for minority manpower utilization, as applicable, and all other requirements, terms and conditions of these bid conditions by submitting a properly signed bid.

The Contractor shall appoint a company executive to assume the responsibility for the implementation of the requirements, terms and conditions of these bid conditions.

16. ASSIGNMENT

A. The Contractor shall not sell, transfer, assign or otherwise dispose of the Contract, contract documents or any portion thereof, or of its right, title, or interest therein, or its obligations thereunder without prior written approval of the Owner.

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

17. PREVAILING WAGE

The successful contractor and all subcontractors will be required to pay laborers on the job in accordance with the

Federal Davis-Bacon Wage Determination included herein.

The Prevailing Wage Program is administered by Amy Hamilton, 538 N Market Street, Wooster, OH 44691.

If any principal contractor or subcontractor appears on a list of violators as filed with the Secretary of State pursuant to Ohio Revised Code Section 4115.133, they are not qualified to bid on this project if within two years of the date of your conviction.

18. OWNER

The terms City, City of Wooster and Owner are interchangeable throughout the contract documents and each term shall mean each of the others.

19. OWNERSHIP OF DOCUMENTS

a. Upon the making of final payment, the Owner shall receive and obtain ownership of the property rights, except for copyrights, of all documents, drawings, specifications, electronic data and information prepared, provided or procured by the Contractor used on this Project and Contractor grants to Owner the right to use all such documents, drawings, specifications, electronic data and information in furtherance of any needs or services related to the Project.

b. If this Agreement is terminated for convenience, the Owner shall receive ownership of the property rights, except for copyrights, of the Contractor's documents upon payment for all work performed in accordance with this Agreement, at which time the Owner shall have the right to use, reproduce and make derivative works from the Contractor 's documents to complete the work. Contractor represents that it will not copyright its own design drawings or specifications or alternatively, if it does copyright its design drawings and specifications, it grants to Owner the absolute right to use the design drawings and specifications to complete the Project following a termination of Contractor's services.

c. If Contractor breaches any of its contractual obligations herein, Owner shall be entitled to take possession and ownership of the property rights, except for copyrights, of the Contractor's documents and shall have the right to use, reproduce and make derivative works from the Contractor's documents to complete the work. Contractor represents that it will not copyright its drawings and/or specifications or alternatively, if it does copyright such drawings and specifications, it grants to Owner the right to use the drawings and specifications to complete the Project, under these circumstances.

d. The Owner may use, reproduce and make derivative works from the Contractor's documents or as-built documents for subsequent renovation and remodeling of the work but shall not use, reproduce or make derivative works from the Contractor's documents or as-built documents for other projects without the written authorization of the Contractor.

e. The Contractor shall obtain from its subcontractors and consultants all necessary property rights and rights of use that correspond to the rights given by the Contractor to the Owner in connection with the Contractor's documents as set forth in this Agreement.

f. The Owner's use of the Contractor’s documents without the Contractor's involvement or on other projects is at the Owner's sole risk.

20. NOTICE OF COMMENCEMENT

To the extent required by law, Owner shall prepare a Notice of Commencement which Contractor will make readily available to all subcontractors and suppliers performing work or providing supplies to the Project. Contractor shall also maintain a copy of the Notice of Commencement at the job site.

21. SAFETY OF PERSONS AND PROPERTY

a. Contractor shall have overall responsibility for safety precautions and programs in the performance of its work on the Project and the work of its subcontractors and suppliers. If requested, Contractor shall erect a construction fence around the work site to prohibit public access to the construction Project site.

b. Owner and Contractor recognize and acknowledge that the provisions of this Agreement providing for Contractor to have overall responsibility for safety precautions and programs in the performance of the Project, including the work of its subcontractors, does not relieve such subcontractors or suppliers of their own responsibility for the safety of persons or property in the performance of their own work, nor for compliance with the provisions of applicable laws and regulations.

c. Contractor shall seek to avoid injury and loss or damage to persons or property by taking reasonable steps to protect employees and other persons at the Project site, materials, supplies and equipment stored at the Project site, the Project and all property located at the work site and adjacent to work areas, whether or not said property or structures are part of the Project or involved in the work.

d. Contractor shall maintain a drug-free and alcohol-free work place and require same of its subcontractors, architects, engineers and consultants. Contractor affirms that it will have a zero tolerance policy regarding illegal drug use or alcohol use by its workers and the workers of its subcontractors, architect, engineers and consultants, while performing any work in furtherance of the Project.

e. Contractor shall designate an individual at the work site in the employ of the Contractor who shall act as its designated safety representative with the duty to prevent accidents. Unless otherwise identified by the Contractor in writing to the Owner, the designated safety representative shall be the Project Superintendent of the Contractor. Contractor will report immediately in writing all accidents or injuries occurring at the work site to the Owner's designated representative. If the Contractor is required to file an accident report with a public authority, Contractor shall furnish a copy of the report to the Owner's representative.

f. Contractor's safety program shall comply with the requirements of all governmental and quasi-governmental authorities having jurisdiction over the work.

g. If the Owner deems any part of the work or work site unsafe, the Owner, without assuming any responsibility or liability for the Contractor's safety program, may require the Contractor to stop the performance of the Project or take corrective actions satisfactory to the Owner, or both. If the Contractor does not adopt such corrective measures, the Owner may perform them and deduct the cost of the corrective measures from the amount paid or due and owing to Contractor. Contractor agrees to make no claim for damages or an increase in compensation based upon the compliance or noncompliance with the Owner's reasonable request.

22. EACH PARTY'S REPRESENTATIVE.

Each party shall designate a person who shall be their authorized representative. Such representatives shall have authority to speak for and bind the Contractor and/or Owner although it is acknowledged that there will be

circumstances in which such representative will need to consult with his or her home office before making binding decisions.

23. HAZARDOUS MATERIALS

a. A hazardous material is any substance or material identified now or in the future as hazardous under any federal, state or local law or regulation, or any other substance or material which may be considered hazardous or otherwise subject to statutory or regulatory requirements governing handling, disposal and/or cleanup. Contractor shall not be obligated to commence or continue work until any hazardous material discovered at the work site has been removed, rendered or determined to be harmless by the Owner as certified by an independent testing laboratory and approved by the appropriate government agency.

b. If after the commencement of the Project, hazardous material is discovered at the work site, the Contractor shall be entitled to immediately stop work in the affected area. Contractor shall report the condition to the Owner, the architect and if required, the government agency with jurisdiction.

c. Contractor shall not be required to perform any work relating to or in the area of hazardous materials without written mutual agreement between Contractor and Owner.

d. The Owner shall be responsible for retaining an independent testing laboratory to determine the nature of the material encountered and whether the material requires corrective measures or remedial action. Such measures shall be the sole responsibility of the Owner and shall be performed in a manner minimizing any adverse effects upon the work. Contractor shall resume work in the area affected by any hazardous material only upon written agreement between the parties after the hazardous material has been removed or rendered harmless and only after approval, if necessary, of the appropriate governmental agency with jurisdiction.

e. Material safety data sheets as required by law and pertaining to materials or substances used or consumed in the performance of the Project, whether obtained by the Contractor, subcontractors, sub subcontractors, Owner or others, shall be maintained at the Project by the Contractor and made available to the Owner and subcontractors upon request.

f. During Contractor's performance of the Project, Contractor shall be responsible for the proper handling of all materials brought to the work site by the Contractor.

g. The terms of this Section shall survive the completion of the Project under this Agreement and/or any termination of this Agreement.

24. MECHANICS' LIENS AND/OR ATTESTED ACCOUNTS

If an Affidavit for Mechanics' Lien, Mechanics' Lien Affidavit for Attested Account or Attest Account is filed on the Project or against the Property of the Owner, by any subcontractor, sub subcontractor, material supplier or other entity, Contractor will cause the lien to be released within 30 days after notice from Owner to do so. Contractor will bond off the lien if necessary in order to accomplish its release. Contractor will hold Owner harmless, defend and indemnify Owner for any and all costs, including attorney's fees, incurred by Owner as a result of an Affidavit for Mechanics' Lien, Affidavit of Attested Account, Mechanics' Lien or Attested Account filed on the Project or property of the Owner.

25. SEVERABILITY

The partial or complete invalidity of any one or more provisions of this Agreement shall not affect the validity or continuing force and effect of any other provision of this Agreement. Any provision deemed invalid shall be modified so as to achieve the intent of the Parties.

26. NO WAIVER OF PERFORMANCE

The failure of either party to insist, in any one or more instances, on the performance of any of the terms, covenants or conditions of this Agreement or to exercise any of its rights, shall not be construed as a waiver or relinquishment of such term, covenant, condition or right with respect to further performance.

27. TITLES AND GROUPINGS

The titles given to the Sections of this Agreement are for ease of reference only and shall not be relied upon or cited for any other purpose. The grouping of the Sections in this Agreement and the Owner's specifications under the various headings is solely for the purpose of convenient organization and in no event shall the grouping of provisions, use of paragraphs or use of headings be construed to limit any provisions.

28. TIME IS OF THE ESSENCE

All time limits stated in the Contract Documents are of the essence of the Agreement. By executing this Agreement, Contractor confirms that the time limits set forth in this Agreement are reasonable.

29. ELECTRONIC AND FAX DOCUMENTS

All electronic and fax copy documents used on the Project or for any means related to the obligations of either Party to this Agreement shall have the full force and effect as an original document.

CITY OF WOOSTER, OHIO

REBID - BIOSOLIDS IMPROVEMENTS PROJECT

SECTION J

SUPPLEMENTARY GENERAL CONDITIONS

Table of Contents
For
Supplementary General Conditions

SUPPLEMENTARY GENERAL CONDITIONS

1. DEFINITIONS

1.1 Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1.2 ADDENDA - Written or graphic instruments issued prior to the execution of the Contract which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATIONS, by additions, deletions, clarifications, or corrections.

1.3 BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed.

1.4 BIDDER - Any person, firm, or corporation submitting a BID for the WORK.

1.5 BONDS - Bid and Contract Bonds and other instruments of security, furnished by the CONTRACTOR and his surety in accordance with the CONTRACT DOCUMENTS.

1.6 CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion or revision in the WORK within the general scope of the CONTRACT DOCUMENTS, or authorizing an adjustment in the CONTRACT PRICE or CONTRACT TIME.

1.7 INTENTIONALLY OMITTED

1.8 CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS.

1.9 CONTRACT TIME - The number of calendar days stated in the CONTRACT DOCUMENTS for the completion of the WORK.

1.10 CONTRACTOR - The person, firm or corporation with whom the OWNER has executed the Contract.

1.11 DRAWINGS - The part of the CONTRACT DOCUMENTS which show the characteristics and scope of the WORK to be performed and which have been prepared or approved by the CITY ENGINEER.

1.12 CITY ENGINEER - The representative of the City of Wooster Division of Engineering, and general representative of the OWNER in all construction administration matters, but also referred to as the Director of Administration unless otherwise advised, the terms Director of Administration and City Engineer shall be interchangeable.

1.13 FIELD ORDER - A written order effecting a change in the WORK not involving an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, issued by the CITY ENGINEER to the CONTRACTOR during construction.

1.14 NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

1.15 NOTICE TO PROCEED - Written communication issued by the OWNER to the CONTRACTOR authorizing it to proceed with the WORK and establishing the date of commencement of the WORK.

1.16 INTENTIONALLY OMITTED

1.17 PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS.

1.18 RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site or any part thereof.

1.19 SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the CONTRACTOR, SUBCONTRACTOR, MANUFACTURER, SUPPLIER or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed.

1.20 SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.

1.21 SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the CONTRACTOR or with any other SUBCONTRACTOR for the performance of a part of the WORK.

1.22 INTENTIONALLY OMITTED

1.23 SUPPLEMENTARY GENERAL CONDITIONS - Modifications to General Conditions and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such requirements that may be imposed by applicable state laws.

1.24 SUPPLIER - Any person or organization who supplies materials or equipment for the WORK, including that fabricated to a special design, but who does not perform labor at the site.

1.25 WORK - All labor necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT.

1.26 WRITTEN NOTICE - Any notice to any party of the Contract relative to any part of this Contract in writing and considered delivered in the service thereof completed, when posted by certified or registered mail to said party at its last given address or delivered in person to said party or its authorized representative on the work, or tendered by facsimile if receipt is shown to demonstrate that the recipient received it and/or by email if the email is either acknowledged as received by the recipient, or there is other proof of its receipt by the recipient, such as a “read receipt” notification.

2. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

2.1 The CONTRACTOR may be furnished additional instructions and detail drawings, by the CITY ENGINEER, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS.

2.2 The additional drawings and instructions thus supplied will become a part of the CONTRACT DOCUMENTS. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

3. SCHEDULES, REPORTS AND RECORDS

3.1 The CONTRACTOR shall submit to the OWNER such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data where applicable as are required by the CONTRACT DOCUMENTS for the WORK to be performed.

3.2 Prior to the first partial payment estimate the CONTRACTOR shall submit construction progress schedules showing the order in which he proposes to carry on the WORK, including dates at which he will start the various parts of the WORK, estimated date of completion of each part and, as applicable:

3.2.1 The dates at which special detail drawings will be required; and

3.2.2 Respective dates for submission of SHOP DRAWINGS, the beginning of manufacture, the testing and the installation of materials, supplies, and equipment.

3.3 The CONTRACTOR shall also submit a schedule of payments that he anticipates he will earn during the course of the WORK.

4. DRAWINGS AND SPECIFICATIONS

4.1 The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the WORK in accordance with the CONTRACT DOCUMENTS and all incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

4.2 In case of conflict between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over scale dimensions, and detailed DRAWINGS shall govern over general DRAWINGS.

4.3 Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions or any inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS shall be immediately reported to the CITY ENGINEER, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk.

5. SHOP DRAWINGS

5.1 The CONTRACTOR shall, at his own expense prior to the manufacture or fabrication of any materials which he is to furnish and which are not built from detailed designs furnished by the CITY ENGINEER, submit for approval of the CITY ENGINEER, four (4) complete sets of detailed SHOP DRAWINGS of such materials. These SHOP DRAWINGS shall be accurate and distinct and shall give all working dimensions, kinds of materials to be used, kinds of machine work and finish to be applied, and like information. These SHOP DRAWINGS shall, in general, pertain to such items as steel reinforcement, piping, electrical installations, valves, pumps, heating equipment, structural steel work, miscellaneous metal and wood work, and any other work similar to the above-mentioned items.

5.2 When submitted for the CITY ENGINEER'S review, SHOP DRAWINGS shall bear the CONTRACTOR'S certification that he has reviewed, checked and approved the SHOP DRAWINGS and that they are in conformance with the requirements of the CONTRACT DOCUMENTS.

5.3 One (1) set of SHOP DRAWINGS furnished by the CONTRACTOR will be returned after approval, the other three (3) sets being retained by the CITY ENGINEER. If required by the CITY ENGINEER, the SHOP DRAWINGS shall be revised and four (4) sets of revised SHOP DRAWINGS shall be furnished until the approval of the CITY ENGINEER has been obtained.

5.4 No work upon the manufacture or the fabrication of any materials shall be done until such approval by the CITY ENGINEER has been obtained. Furthermore, the approval of the SHOP DRAWINGS shall not be interpreted in any way to classify for payment for any particular work.

6. MATERIALS, SERVICES AND FACILITIES

6.1 It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the WORK within the specified time.

6.2 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

6.3 Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

6.4 Materials, supplies and equipment shall be in accordance with samples submitted by the CONTRACTOR and approved by the CITY ENGINEER or his designee.

6.5 Materials, supplies or equipment to be incorporated into the WORK shall not be purchased by the CONTRACTOR or

the SUBCONTRACTOR subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

7. INSPECTION AND TESTING

7.1 All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

7.2 The OWNER shall provide all inspection and testing services not assigned to others by the Contract Documents.

7.3 The CONTRACTOR shall provide at his own expense the testing and inspection services required by the CONTRACT DOCUMENTS.

7.4 If the CONTRACT DOCUMENTS, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR will give the CITY ENGINEER timely notice of readiness. The CONTRACTOR will then furnish the CITY ENGINEER the required certificates of inspection, testing or approval.

7.5 Inspections, tests or approvals by the CITY ENGINEER or others shall not relieve the CONTRACTOR from his obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

7.6 The CITY ENGINEER and his representatives will at all times have access to the WORK. In addition, authorized representatives and agents of any participating Federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The CONTRACTOR will provide proper facilities for such access and observation of the WORK and also for any inspection, or testing thereof.

7.7 If any WORK is covered contrary to the written instruction of the CITY ENGINEER it must, if requested by the CITY ENGINEER, be uncovered for his observation and replaced at the CONTRACTOR'S expense.

7.8 If the CITY ENGINEER considers it necessary or advisable that covered WORK be inspected or tested by others, the CONTRACTOR, at the CITY ENGINEER'S request, will uncover, expose or otherwise make available for observation, inspection or testing as the CITY ENGINEER may require, that portion of the WORK in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such WORK is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such WORK is not found to be defective, the CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate CHANGE ORDER shall be issued.

8. PATENTS

The CONTRACTOR shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the OWNER harmless from loss on account thereof, except that the OWNER shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified; however, if the CONTRACTOR has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the CITY ENGINEER.

9. SURVEYS, PERMITS, AND REGULATIONS

9.1 The OWNER shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the WORK together with a suitable number of bench marks adjacent to the WORK as shown in the CONTRACT DOCUMENTS. From the information provided by the OWNER, unless otherwise specified in the CONTRACT DOCUMENTS, the CONTRACTOR shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

9.2 The CONTRACTOR shall carefully preserve bench marks, reference points and stakes and, in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

9.3 Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for by the CONTRACTOR unless otherwise stated in the SUPPLEMENTAL GENERAL CONDITIONS. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith, he shall promptly notify the CITY ENGINEER in writing, and any necessary changes shall be adjusted as provided in the contract documents.

10. PROTECTION OF WORK, PROPERTY AND PERSONS

10.1 The CONTRACTOR will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the WORK. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2 The CONTRACTOR will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. He will erect and maintain, as required by the conditions and progress of the WORK, all necessary safeguards for safety and protection. He will notify owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR will remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the OWNER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

10.3 In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the CITY ENGINEER or OWNER, shall act to prevent threatened damage, injury or loss. He will give the CITY ENGINEER prompt WRITTEN NOTICE of any significant changes in the WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall thereupon be issued covering the changes and deviations involved.

11. SUPERVISION BY CONTRACTOR

The CONTRACTOR will supervise and direct the WORK. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR will employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CONTRACTOR and all communications given to the supervisor shall be as binding as if given to the CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK.

12. SUBSURFACE CONDITIONS

12.1 The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the OWNER by WRITTEN NOTICE of:

12.1.1 Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT

DOCUMENTS; or

12.1.2 Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in WORK of the character provided for in the CONTRACT DOCUMENTS.

12.2 The OWNER shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK, an equitable adjustment shall be made and the CONTRACT DOCUMENTS shall be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless he has given the required WRITTEN NOTICE; provided that the OWNER may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

13. ASSIGNMENTS

CONTRACTOR shall not sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of its right, title or interest therein, or its obligations thereunder, without written consent of the Owner.

14. SEPARATE CONTRACTS

14.1 The OWNER reserves the right to let other contracts in connection with this PROJECT. The CONTRACTOR shall afford other CONTRACTORS reasonable opportunity for the introduction and storage of their materials and the execution of their WORK, and shall properly connect and coordinate his WORK with theirs. If the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other CONTRACTOR, the CONTRACTOR shall inspect and promptly report to the CITY ENGINEER any defects in such WORK that render it unsuitable for such proper execution and results.

14.2 The OWNER may perform additional WORK related to the PROJECT by himself, or he may let other contracts containing provisions similar to these. The CONTRACTOR will afford the other CONTRACTORS who are parties to such Contracts (or the OWNER, if he is performing the additional WORK himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK, and shall properly connect and coordinate his WORK with theirs.

14.3 If the performance of additional WORK by other CONTRACTORS or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, written notice thereof shall be given to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves him in additional expense or entitles him to an extension of the CONTRACT TIME, he may make a claim therefor as provided in Sections 14 and 15.

15. SUBCONTRACTING

15.1 The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

15.2 The CONTRACTOR shall not award WORK to SUBCONTRACTOR(s), in excess of fifty (50%) percent of the CONTRACT PRICE, without prior written approval of the OWNER.

15.3 The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of the SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

15.4 The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS insofar as applicable to the WORK of SUBCONTRACTORS and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.

15.5 Nothing contained in this CONTRACT shall create any contractual relation between any SUBCONTRACTOR and the OWNER.

16. CITY ENGINEER'S AUTHORITY

16.1 The CITY ENGINEER and/or Director of Administration shall act as the OWNER'S representative during the construction period. He shall decide questions which may arise as to quality and acceptability of materials furnished and WORK performed. He shall interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The CITY ENGINEER will make visits to the site and determine if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

16.2 The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship and execution of the WORK. Inspections may be made at the factory or fabrication plant of the source of material supply.

16.3 The CITY will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

16.4 The CITY shall promptly make decisions relative to interpretation of the CONTRACT DOCUMENTS.

17. LANDS AND RIGHTS-OF-WAY

17.1 Prior to issuance of NOTICE TO PROCEED, the OWNER shall obtain all land and rights-of-way necessary for carrying out and for the completion of the WORK to be performed pursuant to the CONTRACT DOCUMENTS, unless otherwise mutually agreed.

17.2 The OWNER shall provide to the CONTRACTOR information which delineates and describes the lands owned and rights-of-way acquired.

17.3 The CONTRACTOR shall provide at his own expense and without liability to the OWNER any additional land and access thereto that the CONTRACTOR may desire for temporary construction facilities, or for storage of materials.

18. GUARANTY

The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of two (2) years from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees for a period of two (2) years from the date of SUBSTANTIAL COMPLETION of the system that the completed system is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other WORK that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred. The Contract BOND shall remain in full force and effect through the guarantee period.

The following chart represents minimum bond amounts for the Maintenance and Guaranty Bond required at completion of the project. Final amounts will be established by the City Engineer based on project type and complexity.

Two Year Maintenance and Guaranty Bond

Project Costs/Bond Amounts

Project Type	≤ $100,000	> $100,000 – $500,000	≥ $500,000
Utility Projects	50%	25%	10%
Roadway Projects	75%	50%	25%
Mechanical/Equipment/ Building Projects	100%	75%	50%

19. WORKING FACILITIES

19.1 The CONTRACTOR will be allowed the use of as much of the site designated for the proposed WORK as is necessary for his operations unless noted otherwise in the DRAWINGS, but he must provide all necessary access to public or private property, the cost of which shall be included in the prices BID for the various items of the WORK to be performed under this CONTRACT.

19.2 Whenever it is required as a part of this CONTRACT to perform the work within the limits of private property, or in public rights-of-way, such WORK shall be done in conformity with all permits and agreements between the OWNER and the owner of such private property or rights-of-way. Whether or not such a condition be part of the agreement, care shall be taken to avoid injury to the premises entered, which premises shall be left in a neat and orderly condition, by the removal of rubbish and the grading of surplus materials and the restoration of said private property to the same general conditions as at the time of entry for WORK to be performed under this CONTRACT.

20. PROGRAM AND METHOD OF CONSTRUCTION

20.1 The CONTRACTOR shall comply with all provisions of "SPECIFIC SAFETY REQUIREMENTS OF THE INDUSTRIAL COMMISSION OF OHIO RELATING TO CONSTRUCTION," Current Edition, and the U.S. Department of Labor "Safety and Health Regulations for Construction" identified as Chapter XVII of Title 29, Code of Federal Regulations (CFR) Part 1926 (formerly Part 1518) and subsequent amendments.

20.2 If, at any time before the commencement or during the progress of the WORK, or any part of it, such methods, features and appliances used or to be used, appear to the CITY ENGINEER as unsafe, insufficient or improper, he may order the CONTRACTOR to increase their safety or sufficiency, or to improve their character, and the CONTRACTOR shall conform to such orders; but the failure of the CITY ENGINEER to demand any increase of such safety, sufficiency, adequacy of any improvement shall not release the CONTRACTOR from his obligation to secure the safe conduct and quality of the WORK specified.

21. OWNERSHIP OF MATERIALS

Materials encountered in the WORK and required to be removed under this CONTRACT which are in a reusable condition as determined by the CITY ENGINEER including, but not limited to, items of equipment, piping, castings, valves, excavated materials, and electrical boxes and fixtures shall remain the property of the OWNER. All such materials which are not to be reused in the WORK shall be stored adjacent to the WORK by and at the expense of the CONTRACTOR and as directed by the CITY ENGINEER.

22. STORING OF MATERIALS

22.1 All materials required in the WORK may be stored on the project site, or on the right-of-way, sides of the roadway or parking area of the streets or highways in which the WORK is to be constructed, or upon the street intersections adjoining thereto, if approved by the CITY ENGINEER, but all such materials, tools and machinery shall be neatly and compactly piled in such a manner as to cause the least inconvenience to property owners and traffic.

22.2 All fire hydrants must at all times be kept free and unobstructed and water and gas shut off boxes and underground power and telephone line manholes must be left uncovered by such materials.

22.3 Materials, tools and machinery shall not be piled or placed against trees. All materials, tools, machinery, etc., stored upon public thoroughfares, must be provided with warning lights or flares at night time to warn traffic of such obstructions.

23. MEASURES OF QUANTITIES

23.1 To aid the CITY ENGINEER in determining quantities, the CONTRACTOR shall, whenever so requested, provide scales, equipment and assistance for weighing of or measuring any of the materials. It is understood and agreed that a "ton" shall mean the short ton or two thousand (2,000) pounds.

23.2 Weights and measures of quantities for payment will be the actual weight or actual measure, and no special or trade or so termed customary allowances will be made, nor will any material which is lost or misplaced be included for payment.

23.3 Where WORK is to be paid for by units of length, area or volume, only the net amount of the WORK actually called for and completed, as it shall appear in the finished WORK shall be paid for.

23.4 For the estimating of quantities in which the computation of area or volume by geometric methods would be comparatively laborious, it is agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of such areas or volumes.

23.5 The estimated quantities of the various classes of WORK to be performed under this CONTRACT are approximate, and are for the purpose of comparing, on a uniform basis, the BIDS offered.

23.6 Neither the OWNER nor the CITY ENGINEER are to be held responsible if, upon the completion of the WORK, the actual quantities are found to be greater or less than the estimated quantities. The CONTRACTOR shall make no claim for anticipated profits or loss of profits because of a difference between actual and estimated quantities.

24. LINES AND GRADES

24.1 All WORK under this CONTRACT shall be built in accordance with the lines and grades shown on the DRAWINGS or as given by the CITY ENGINEER. The CONTRACTOR will be required to furnish such materials and unskilled assistance as may be necessary for setting and preserving line and grade stakes.

24.2 The CONTRACTOR shall inform the CITY ENGINEER at least forty-eight (48) hours in advance of his need for line or grade stakes. It shall be the duty of the CONTRACTOR to carefully preserve all stakes and marks used or given by the CITY ENGINEER. When approved by the CITY ENGINEER, the CONTRACTOR may elect to use a laser beam as an alternative for horizontal and vertical control of sanitary sewers. The laser unit shall be set up in such a manner that the alignment of the beam is through the pipe directly on the centerline of the pipe or outside the pipe directly above and parallel to the centerline of the pipe. If the laser unit is set up on the centerline of the pipe, a blower shall be used to provide positive continuous air circulation within the pipe. A target shall be established on line and grade, to provide a method of checking the setting of the laser beam as construction progresses. The CONTRACTOR shall provide means to ensure the grade pole is plumb when checking pipe grade. The grade pole shall be set on the invert of the pipe when checking alignment and grade.

24.3 The figures given in the SPECIFICATIONS or upon the DRAWINGS after the word "Elevation" or an abbreviation of it, shall mean distances in feet above Mean Sea Level Datum.

25. WORK IN FREEZING WEATHER

Any WORK which may be subject to damage by frost shall be suspended during periods of freezing weather unless written authorization to proceed is obtained from the CITY ENGINEER. When WORK is authorized to proceed under such a condition, the CONTRACTOR shall provide approved facilities for heating the materials and protecting the finished work.

26. TEST HOLES

26.1 If the BIDDER desires to obtain information as to soil conditions, the OWNER will afford him an opportunity, at his own expense, to make borings or to dig test pits on the site of the WORK.

26.2 The location of such boring or test pits shall be subject to approval by the OWNER and all such borings and test pits shall be restored to a condition satisfactory to the OWNER.

27. NOTIFICATION OF UTILITIES

27.1 Before starting construction in any street or road, the CONTRACTOR shall notify all utility companies, in writing, of the date he proposes to begin his operations. Such notice shall be given sufficiently in advance to permit the utility companies to make adequate provisions for protecting their pipe lines, cables, poles, etc. One copy of the CONTRACTOR'S letter of notification shall be delivered to the CITY ENGINEER.

27.2 Where the CONTRACTOR'S operations endanger the security of any utility pole, he shall support such pole in a manner satisfactory to the CITY ENGINEER and shall notify the owner of the pole. The cost of supporting poles shall be paid by the CONTRACTOR.

27.3 The cost of any damages caused to utility company facilities shall be the responsibility of the CONTRACTOR.

28. SEWAGE, SURFACE AND FLOOD FLOWS

28.1 The CONTRACTOR shall furnish all the necessary equipment, shall take all necessary precautions, and shall assume the entire cost of handling and properly disposing of any sewage, seepage, storm surface water and flood flows which may be encountered at any time during the construction of the WORK.

28.2 The manner of providing for these flows shall meet with the approval of the CITY ENGINEER, and the entire cost of said work shall be included in the price stipulated for the various items of the WORK to be performed under this CONTRACT.

29. USE OF STREETS

29.1 During the progress of the WORK, the CONTRACTOR shall make ample provision for both vehicular and foot traffic on any public road, and shall indemnify and save harmless the OWNER from any expense whatsoever due to his operations over said roadways and streets. The CONTRACTOR shall also provide free access to all fire hydrants, water and gas valves located along the line of his WORK.

29.2 Gutters and waterways must be kept open or other provisions made for the removal of storm water. The CONTRACTOR shall lay and maintain temporary driveways, bridges, and crossings, such as, in the opinion of the CITY ENGINEER, are necessary to reasonably accommodate the public.

29.3 In the event of the CONTRACTOR'S failure to comply with these provisions, the OWNER may cause the same to be performed and will deduct the cost of such WORK from any monies due or to become due the CONTRACTOR under this

contract, but the performance of such WORK by the OWNER shall not release the CONTRACTOR from his general or particular liability for the safety of the public or the WORK.

30. OBSTRUCTIONS ENCOUNTERED

30.1 In addition to showing the structures to be built under this CONTRACT, the DRAWINGS show certain information obtained by the CITY ENGINEER regarding the pipes, conduits and other structures which exist along the lines of the WORK, both at and below the surface of the ground. The OWNER expressly disclaims any responsibility for the accuracy or completeness of the information given on the DRAWINGS with regard to existing pipes, conduits, or structures. If an interference is encountered at grade with pipes, conduits, or structures not shown on the plans or otherwise indicated, the authorized elimination of the interference shall be paid in accordance with Section 12, Change Orders and Changes to Work of the General Conditions, providing the CONTRACTOR has complied with the requirements of Section 12 of these special conditions.

30.2 The CONTRACTOR shall support and protect all pipes, conduits, and other structures which may be encountered during the construction of the WORK, and to make good all damages done to such pipes, conduits, and other structures as provided in these SPECIAL CONDITIONS.

31. MONUMENTS AND LANDMARKS

Monuments or landmarks shall not be disturbed or removed by the CONTRACTOR or any of his employees without the written consent of the CITY ENGINEER. Any monument or landmark so removed will be replaced by the CONTRACTOR at his expense. The cost thereof shall be retained from the monies due or to become due the CONTRACTOR under this CONTRACT.

32. PROTECTION OF EXISTING TREES AND SHRUBBERY

32.1 When ordered by the CITY ENGINEER, the CONTRACTOR shall dig up, handle, protect and properly reset hedges, small trees and shrubbery along the line of or adjacent to the WORK, and shall take all reasonable care in this WORK.

32.2 Tree roots shall not be mutilated nor shall they be cut except by permission of the CITY ENGINEER. When permitted to cut tree roots, the ends shall be cut off smooth, without splitting or shattering. The trunks of the trees shall be carefully protected from damage, and if unavoidable damage occurs, the injured portions shall be neatly trimmed and covered with an application of grafting wax.

32.3 Excavating machinery, cranes, etc., shall be handled with care to prevent damage to shade trees, particularly to overhanging branches, and shall not be cut off except by special permission of the CITY ENGINEER.

32.4 No special compensation will be made for the protecting of existing trees and shrubbery, but such cost shall be considered as having been included in the prices stipulated for the various items of WORK to be performed under this CONTRACT.

33. RESIDENT PROJECT REPRESENTATIVE

33.1 The RESIDENT PROJECT REPRESENTATIVE if employed or assigned for the Project, shall be the agent and shall act under the supervision and direction of the CITY ENGINEER.

33.2 The duties and responsibilities of the RESIDENT PROJECT REPRESENTATIVE shall be:

33.2.1 Schedule: Review the construction schedule prepared by the CONTRACTOR for compliance with the CONTRACT and give written advice to the CITY ENGINEER concerning its acceptability.

33.2.2 Conferences: Attend preconstruction conferences. Arrange a schedule of progress meetings and other job conferences as required in consultation with the CITY ENGINEER and notify those expected to attend in advance.

Maintain and circulate copies of records of the meetings.

33.2.3 Liaison:

a. Serve as the CITY ENGINEER'S liaison with the CONTRACTOR working principally through the CONTRACTOR'S field superintendent. Alert the CONTRACTOR, through his field superintendent, to the hazards involved in accepting and acting upon any instructions other than such instructions transmitted through the CITY ENGINEER.

b. Cooperate with the CONTRACTOR in his dealings with the various local agencies having jurisdiction over the WORK in order to complete service connections to public utilities and facilities.

33.2.4 Approvals: When required, assist the CITY ENGINEER in obtaining from the CONTRACTOR a list of his proposed SUPPLIERS and SUBCONTRACTORS.

33.2.5 Samples: Assist the CITY ENGINEER in obtaining field samples of materials delivered to the site which are required to be furnished, and keep a record of actions taken by the CITY ENGINEER.

33.2.6 Shop Drawings:

a. Receive approved SHOP DRAWINGS and other submissions from the CITY ENGINEER; record data received, maintain a file of the DRAWINGS and submissions, and check construction for compliance with them.

b. Alert the CONTRACTOR'S field superintendent when he observes materials or equipment being installed before approval of SHOP DRAWINGS or samples, where such are required, and advise the CITY ENGINEER when he believes it is necessary to disapprove WORK as failing to conform to the CONTRACT DOCUMENTS.

33.2.7 Review of Work, Inspections and Tests:

a. Conduct on-site observations of the WORK in progress for the CITY ENGINEER as a basis for determining that the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

b. Verify that tests, including equipment and systems start-up, which are required by the CONTRACT DOCUMENTS are conducted and that the CONTRACTOR maintains adequate records thereof; observe, record and report to the CITY ENGINEER appropriate details relative to the test procedures and start-ups.

c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the WORK, record the outcome of these inspections and report to the CITY ENGINEER.

33.2.8 Interpretation of Contract Documents: Transmit to the CONTRACTOR the CITY ENGINEER'S interpretations of the CONTRACT DOCUMENTS.

33.2.9 Modifications: Consider and evaluate the CONTRACTOR'S suggestions for modifications in DRAWINGS or SPECIFICATIONS and report them with recommendations to the CITY ENGINEER.

33.2.10 Records:

a. Maintain at the job site orderly files for correspondence, reports of job conferences, SHOP DRAWINGS and other submissions, reproductions of original CONTRACT DOCUMENTS including all ADDENDA, CHANGE ORDERS and additional DRAWINGS issued subsequent to the award of the CONTRACT, the CITY ENGINEER'S interpretations of the CONTRACT DOCUMENTS, progress reports, and other WORK related documents.

b. Keep a diary or log book, recording hours on the job site, weather conditions, list of visiting officials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures.

c. Record names, addresses and telephone numbers of all CONTRACTORS, SUBCONTRACTORS and major material SUPPLIERS.

d. Maintain a set of DRAWINGS on which authorized changes are noted, and deliver to the CITY ENGINEER at the completion of the WORK.

33.2.11 Reports:

a. Furnish the CITY ENGINEER periodic reports as required of progress of the WORK and the CONTRACTOR'S compliance with the approved construction schedule.

b. Consult with the CITY ENGINEER in advance of scheduled major tests or start of important phases of the WORK.

33.2.12 Payment Requisitions: Review applications for payment with the CONTRACTOR for compliance with the established procedure for their submission and forward them with recommendations to the CITY ENGINEER, noting particularly their relation to the WORK completed and materials and equipment delivered at the site.

33.2.13 Guarantees, Certificates, Maintenance and Operation Manuals: During the course of the WORK, assemble guarantees, certificates, maintenance and operation manuals and other required data to be furnished by the CONTRACTOR and upon acceptance of the WORK, deliver this material to the CITY ENGINEER for his approval.

33.2.14 Completion:

a. Prior to final inspection, submit to the CONTRACTOR a list of observed items requiring correction and verify that each correction has been made.

b. Conduct final inspection in the company of the CITY ENGINEER and the OWNER and prepare a final list of items to be corrected.

c. Verify that all items on final list have been corrected and make recommendations to the CITY ENGINEER concerning acceptance.

33.3 The RESIDENT PROJECT REPRESENTATIVE shall not have authority to perform any of the following except upon written instructions of the CITY ENGINEER;

33.3.1 Authorize any deviation from the CONTRACT DOCUMENTS.

33.3.2 Undertake any of the responsibilities of the CONTRACTOR, the SUBCONTRACTOR or the CONTRACTOR'S field superintendent.

33.3.3 Expedite the WORK for the CONTRACTOR.

33.3.4 Advise on or issue directions relative to any aspect of the construction technique or sequence unless a specific technique or sequence is called for in the CONTRACT DOCUMENTS.

33.3.5 Authorize the OWNER to occupy the PROJECT in whole or in part prior to final acceptance of the WORK.

33.3.6 Participate in specialized field or laboratory tests.

33.3.7 Act as foremen or perform other duties for the CONTRACTOR nor interfere with the management of the WORK. Any instructions which the RESIDENT PROJECT REPRESENTATIVE may give the CONTRACTOR shall in no way be construed as committing the OWNER in any way, nor as releasing the CONTRACTOR from the fulfillment of the CONTRACT.

34. OPERATION AND MAINTENANCE MANUALS

34.1 The CONTRACTOR shall at his own expense, submit to the CITY ENGINEER, four (4) copies of the Operation and Maintenance Manuals for each and every item of mechanical or electrical equipment included in the WORK under this CONTRACT. The Operation and Maintenance Manuals shall address, as a minimum, the equipment specifications,

installation procedure, preparation for operation, theory of operation, method of operation, routine maintenance including lubrication, trouble-shooting, service contacts, and exploded diagrams with parts listed.

34.2 Final payment for WORK under this CONTRACT will not be made until all operation and maintenance manuals, as requested herein, are received by the CITY ENGINEER.

35. PROTECTION OF PUBLIC AND SAFETY

The CONTRACTOR, when performing any work on any roads, streets, or highways or so closely adjacent thereto to create hazards for the public or for themselves, shall provide protection in accordance with Part 6 – Temporary Traffic Control, of the "Ohio Manual of Uniform Traffic Control Devices." This manual is published by the Ohio Department of Transportation. The CONTRACTOR shall also comply with Section 107.07 of ODOT Construction and Material Specifications.

36. ODOT REFERENCE

Wherever in the contract documents, reference is made to the Construction and Material Specifications of the Ohio Department of Transportation (ODOT), current edition, the provisions of the referenced item shall have the full force and effect as if reproduced herein in their entirety. However, the method of measurements, basis of payments and pay items shall be as described in the Material Specifications or bid proposal forms. The CONTRACTOR shall be responsible for providing his own copy of the ODOT Construction and Material Specifications.

37. DOMESTIC STEEL USE REQUIREMENTS

Furnish steel and iron products that are made in the United States according to the applicable provisions of Federal regulations stated in 23 CFR 635.410 and State of Ohio laws, and ORC 153.011 and 5525.21. "United States" means the United States of America and includes all territory, continental or insular, subject to the jurisdiction of the United States.

A. Federal, State, City Requirements: All steel or iron products incorporated permanently into the Work must be made of steel or iron produced in the United States and all subsequent manufacturing must be performed in the United States. Manufacturing is any process that modifies the chemical content; physical shape or size; or final finish of a product. Manufacturing begins with the initial melting and mixing, and continues through the bending and coating stages. If a domestic product is taken out of the United States for any process, it becomes a foreign source material.

B. Exceptions: The City Engineer may grant specific written permission to use foreign steel or iron products in bridge construction and foreign iron products in any type of construction. The City Engineer may grant such exceptions under either of the following conditions:

1. The cost of products to be used does not exceed 0.1 percent of the total Contract cost, or $2,500, whichever is greater. The cost is the value of the product as delivered to the project.
2. The specified products are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet the requirements of the Contract Documents. The City Engineer may require the Contractor to obtain letters from three different suppliers documenting the unavailability of a product from a domestic source, if the shortage is not previously established.

C. Proof of Domestic Origin: Furnish documentation to the Engineer showing the domestic origin of all steel and iron products covered by this section, before they are incorporated into the Work. Products without a traceable domestic origin will be treated as a non-domestic product.

BID FORM

Project Identification: Contract No. GC 24-01
Rebid - Biosolids Upgrade Project
RETTEW Project No.: 122022001

Name of Bidder: _____

This Bid is submitted to: City of Wooster
538 N Market Street
Wooster, OH 44691

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.
2. Bidder accepts all of the terms and conditions of the Legal Notice and Instructions to Bidders, including without limitation those dealing with the disposition of Bid Security. This Bid will remain subject to acceptance for 60 days after the day of Bid opening.
3. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

    a. Bidder has examined and carefully studied the Contract Documents and the following Addenda receipt of all which is hereby acknowledged:

    _____
    _____
    _____

    b. Bidder has visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the Work.
    c. Bidder is familiar with and is satisfied as to all federal, state and local laws and regulations that may affect cost, progress, performance and furnishing of the Work.
    d. If applicable, Bidder has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except underground facilities) that have been identified in the Supplementary Conditions as referenced in Article 4 of the General Conditions. Bidder accepts the determination set forth in Paragraph SC-4.02 of the Supplementary Conditions of the extent of the "technical data" contained in such reports and drawings upon which Bidder is entitled to rely as provided in Article 4 of the General Conditions. Bidder acknowledges that such reports and drawings are not Contract Documents and may not be complete for Bidder's purposes. Bidder acknowledges that OWNER and ENGINEER do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to underground facilities at or contiguous to the site. Bidder

has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and underground facilities) at or contiguous to the site or otherwise that may affect cost, progress, performance or furnishing of the Work or that may relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Contract Documents.

e. Bidder is aware of the general nature of the Work to be performed by OWNER and others at the site that relates to work for which this Bid is submitted as indicated in the Contract Documents.

f. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.

g. Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities or discrepancies that Bidder has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to Bidder, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.

h. This Bid is genuine and not made in the interest of or on the behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER. Bidder is aware that they must complete a minimum of fifty (50) percent of the work on the project with its own forces.

4. Bidder will submit their bid according to a base bid and add alternate. Each is described below:
   a. Base Bid: Includes all work shown on Drawings as marked as Base Bid.
   b. Add Alternate Bid Items: Includes potential additional work as shown on the Drawings as marked as Add Alternate. Refer to Section 011100 – Summary of Work.
   c. Contract will be awarded based on lowest responsive Base Bid. Owner may add any or no alternates to the lowest responsive Base Bid.

Item		Estimated Quantity	Unit	Unit Price	Total Price
1	Biosolids Upgrade Project - BASE BID	1	LS		

Item		Estimated Quantity	Unit	Unit Price	Total Price
2	ADD ALTERNATE – Modifications to T-004 including replacement of mechanical mixing to jet mixing, and replacement of double membrane gas holder cover.	1	LS		

TOTAL LUMP SUM BID: (figures)
Dollars and Cents (written)

5. Bidder agrees that the Work will be substantially complete within 365 calendar days after the date when the contract time commences to run as provided in the General Conditions, and completed and ready for final payment within 30 calendar days after the date of Substantial Completion. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified in the Agreement.
6. The required Bid Security and required certifications identified in the Contract Documents are to be provided with bid, either electronic or paper copy.
7. Communications concerning this Bid shall be addressed to the address of Bidder indicated below or the following address:

   _____
   _____
   _____
   _____

8. The terms used in this Bid that are defined in the General Conditions or Instructions will have the meanings assigned to them in the General Conditions or Instructions.

SUBMITTED on .

If Bidder is:

An Individual

By: _____ (SEAL)
(INDIVIDUAL'S NAME)

doing business as _____
Business Address: _____

_____

Phone No.: _____

A Partnership

By: _____ (SEAL)
(FIRM'S NAME)

_____
(GENERAL PARTNER)

Business Address: _____

_____

Phone No.: _____

A Corporation

By: _____ (SEAL)
(CORPORATION'S NAME)

_____
(STATE OF INCORPORATION)

By: _____ (SEAL)
(NAME OF PERSON AUTHORIZED TO SIGN)

_____
(TITLE)

(Corporate Seal)

Attest: _____
(SECRETARY)

Business Address: _____

_____

Phone No.: _____

A Joint Venture

By: _____ (SEAL)
(NAME)

_____
(ADDRESS)

By: _____ (SEAL)
(NAME)

_____
(ADDRESS)

Phone Number and Address for Receipt of Official Communications.

_____

_____

_____

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above.)

SECTION 004300 – BASIS OF BID SUPPLEMENT

Design of this project is based upon the major equipment item or product identified in the *Schedule of Manufacturers and Suppliers for "Basis of Bid" Items* and the Contract Documents are based upon the equipment or products available from the manufacturers or suppliers listed on the following *Schedule of Manufacturers and Suppliers for "Basis of Bid" Items.* Bidder must use the manufacturer or supplier of each item of equipment or product listed in the schedule in their bid. The Bidder Total Bid Price must be based upon this list.

If the Bidder desires to propose an alternate manufacturers or supplier for the "Basis of Bid" items, the Bidder must write in the name of no more than one alternate per equipment item in the space provided in *Schedule of Alternate Suppliers*. If an alternate manufacturer or supplier is proposed, the Bidder must insert the amount to be added or deducted, as a lump sum, from the Total Bid Price. If the alternate manufacturer or supplier is eventually approved by the Engineer and accepted by the Owner, the Bidder must use the listed alternate manufacturer or supplier. If the proposed alternate is not approved by the Engineer or not accepted by the Owner, the Bidder must use the listed "Basis of Bid" manufacturer or supplier. After receipt of Bids by the Owner, Bidders may not alter the *Schedule of Alternate Suppliers* or proposed alternative manufacturers or suppliers not indicated in the Contract Documents.

The additive or deductive amount specified for alternate manufacturers or suppliers will not be used in determining the Successful Bidder.

The Bidder shall include in his bid all additional construction costs (mechanical, architectural, structural, electrical, HVAC, and engineering redesign costs), associated with that alternate manufacturer or supplier. The Bidder shall reimburse the Owner for any additional costs incurred by the Owner related to the implementation of the alternate manufacturer or supplier from other Contractors. The Bid shall also include any paid licenses necessary for the use of the equipment if required by the manufacturer.

The Bidder agrees that delays caused by redesign necessary for Alternate major equipment or products shall not constitute grounds for a contract modification, change order, claim, or extension of contract time.

Schedule of Manufacturers and Suppliers for "Basis of Bid" Items

SPECIFICATION	EQUIPMENT/PRODUCT	MANUFACTURER/SUPPLIER
467116	Gravity Belt Thickeners	Alfa-Laval, Inc.or Komline Sanderson or BDP Industries
467330	Biogas Storage Tanks	JDV or Membrane Systems Europe
432600	Specialized Liquid Pumps – Dry Pit Chopper Pumps	Vaughan or JDV

Schedule of Alternate Suppliers

SPECIFICATION	EQUIPMENT PRODUCT	ALTERNATE MANUFACTURER SUPPLIER	MODIFICATION +ADDITION (DEDUCT)

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 011100 - SUMMARY OF PROJECT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT DESCRIPTION

A. Project Identification: REBID - BIOSOLIDS UPGRADE PROJECT
   1. Project location: 1123 Columbus Rd, Wooster, OH 44691
   2. OWNER: The City of Wooster.

B. ENGINEER Identification: The Contract Documents, dated April 2024, were prepared for Project by:

   RETTEW Associates, Inc., 3475 Forest Lake Drive, Suite 100, Uniontown, OH 44685

C. The project involves:

   Biosolids Upgrade Project: BASE BID
   1. The work generally includes the construction of addition to the existing wastewater treatment plant biosolids processes, and related work to items listed below.
   2. Replacement of Mechanical Mixing Units with Jet Mixing in Tanks T-001, T-002, and T-003.
   3. Replacement of Two (2) Double Membrane Digester Gas holders and Appurtenances in T-002 and T-003.
   4. Modification of Existing Digester Gas Piping including gas safety devices.
   5. Replacement of Air System for Biogas Covers for T-002, and T-003.
   6. Installation of Biogas Blower to maintain low pressure in T-004. (Removed if Alternate #1 is added to the project.)
   7. Replacement of Existing Flare.
   8. Replacement of existing Gravity Belt Thickener.

   Alternate #1 – Modifications to T-004 (Mixing and Membrane Cover Replacement)
   1. Replacement of Double Membrane Digester Gas holders and Appurtenances.
   2. Replacement of Air System for Biogas Covers.
   3. Replacement of Mechanical Mixing Units with Jet Mixing.

D. Funding Source:

   Funding source is City funds, however, the City is seeking direct reimbursement under the 2022 Inflation Reduction Act for the Section 48 Tax Credit. See Supplemental Conditions in the Project

Manual, however, the domestic content requirements found in the Inflation Reduction Act do apply to the projects.

1.3 MISCELLANEOUS PROVISIONS

A. CONTRACTOR'S use of Premises:
   1. Coordinate use of premises with other contractors, OWNER, and ENGINEER.
   2. CONTRACTOR shall assume full responsibility for security of all their and their subcontractors' materials and equipment stored on the site.
   3. CONTRACTOR shall move any stored items that interfere with operations of others if directed by the OWNER or ENGINEER.
   4. CONTRACTOR shall obtain and pay for use of additional storage or work areas if needed to perform the Work.

B. Sequence of Construction
   1. Prior to commencing Work, the CONTRACTOR shall refer to Specification Section 011400 – Maintenance of Operation and submit a proposed sequence of construction to the ENGINEER for review and approval. The CONTRACTOR is responsible for overall coordination of all Work associated with this Project.

PART 2 - PRODUCTS
Not used.

PART 3 - EXECUTION
Not used.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 011400 – MAINTENANCE OF OPERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract Documents including General and Supplementary Conditions and Division 01 specifications sections apply to all work in this section.

1.2 COORDINATION OF WORK OF SEPARATE CONTRACTS

A. The General Construction Contractor is responsible for the overall coordination of the construction work of the Project. As specified in Section 013300, the General Construction Contractor shall prepare a Construction Progress Schedule in a form acceptable to the Engineer. The Schedule shall indicate his work as well as the phasing of each Contractor and Subcontractor's work.

B. The Construction Progress Schedule shall then be reviewed at a joint meeting of the individuals Contractors, the Engineer, and the Owner. At this meeting adjustments will be made to the Schedule that are agreeable to the individual Contractors and seem appropriate for the timely completion of the Project. After revisions have been made the Schedule will be signed by each Contractor and issued to the appropriate parties of each Contract for their use in completing their work.

C. The Engineer will monitor the progress of each Contractor and review the status of completion of their work at the regular project meetings. If one or more of the individual Contractors is delaying the progress of the Project, it shall be the responsibility of that Contractor or Contractors causing the delay to take necessary action to bring their portion of the Project back on schedule.

1.3 COORDINATION AND INTERFERENCES

A. The Engineer's Drawings are generally diagrammatic and indicative of the work and as such cannot show actual construction conditions. Modifications in the work to compensate for minor interferences and structural obstructions shall be accomplished as part of the Work at no increase in Contract Price.

B. Each Contractor is responsible for preparing completely dimensioned installation of setting drawings of the various equipment and work requiring openings or other provisions to be made in the structures construction of the General Construction Contract. Such drawings shall have the Engineer's approval prior to their use.

C. The individual Contractors shall not unload or store material where it will interfere with the progress of the Project or retard the work of other Contractors from proceeding with their work.

D. Work Interference's: Each Contractor shall construct their Systems, Materials and Equipment in a manner not to delay or interfere with other operations or work of other Contracts in the Project.

1. Prior to making Product installations, coordinate such locations with other operation of work, especially in congested areas, such as mechanical equipment rooms and above hung ceilings (if any).
2. In the event that interferences develop, the Engineer's decision will be final and not additional compensation will be allowed for relation of the affected Contractor's Products.

E. Contract Interface:
1. Work Interfacing with Other Contracts: Each Contractor is responsible for performing the interface Work of his Contract in cooperation with Work of other Contracts.
2. Electrical Work Interface:
   a. Make connections of electrical power and control services specified in the various Specifications Sections of the Electrical Contract of those Products of the Electrical Contract and other Contracts requiring such connections.
   b. The electrical components or apparatus furnished as part of the Products under other Contracts will be installed or mounted as work of those Contracts.
   c. Electrical motors indicated on Drawings, except motors provided integral with Products of the Electrical Contract, will be furnished under other Contracts for this Project, but shall be connected under the Electrical Contract, except for submersible motors that are to be connected by the General Construction Contractor.
   d. Provide motor starters and variable frequency drives (VFDs) as work of the Electrical Contract except as otherwise specified.

1.4 MAINTENANCE OF UTILITY OPERATIONS DURING CONSTRUCTION

A. Project Requirements:
1. The existing plant will be maintained in continuous operation by the Owner during the entire construction period of all Contracts as hereinafter specified. The intent of this section is to outline the minimum requirements necessary to provide continuous treatment and disinfection of the full plant flow throughout the construction period.
2. Work under each Contract shall be scheduled and conducted by each Contractor so as not to impede any treatment process, reduce the quality of the plant effluent or cause odor or other nuisance except as explicitly permitted hereinafter. In performing the work shown and specified, each Contractor shall plan and schedule his work to meet the plant and collection system operating requirements, and the constraints and construction requirements as outlined in this Section. No discharge of inadequately treated wastewater shall be allowed. Contractors shall pay all civil penalties, costs, assessments, etc., associated with any discharge or inadequately treated wastewater associated with the Contractor's work.
3. Each Contractor shall schedule the Work so that the plant is maintained in continuous operation. All treatment processes shall be maintained in continuous operation during the construction period except during approved process interruptions. All short-term system or partial systems shutdowns and diversions shall be approved by the Engineer. Long-term process shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgment of the Engineer a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Owner, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed and normal plant operation is restored. If the Contractor completes all required Work before the

specified shutdown period has ended, the Owner may immediately place the existing system back into service. Shutdowns shall be fully coordinated with the Plant Superintendent at least 24 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short-term and extended shutdowns and diversions.

4. The General Contractor shall be responsible for coordinating the general construction schedule and for ensuring that permanent or temporary power is available for all existing, proposed, and temporary facilities that are required to be on line at any given time.
5. The General Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the Owner and provided that all requirements of these Specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section shall be consecutive calendar days.

B. General Operating and Construction Requirements:

1. Access to Plant Site, Roadways, and Parking Areas: An unobstructed traffic route through the Main Gate shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Parking for personal vehicles of construction personnel shall be allowed within the fence of the treatment plant as shown on the Contract Drawings and as directed by the Owner. The General Contractor shall be responsible for providing access to and for preparing and maintaining/approved parking areas onsite. All Contractors shall each be responsible for furnishing additional off-site parking for their employees if required. An unobstructed traffic route around the plant site shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Vehicular access to the treatment units and buildings for Owner personnel shall be maintained at all times by the Contractor. The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and the Contractor shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the plant shall be repaired, graded, seeded, etc. as necessary to match pre-existing conditions.
2. Personnel Access: Treatment plant personnel shall have access to all areas which remain in operation throughout the construction period. The Contractor shall locate stored material, dispose of construction debris and trash, provide temporary walkways, provide temporary lighting, and other such work as directed by the Engineer to maintain personnel access to areas in operation. Access and adequate parking areas for plant personnel must be maintained throughout construction.
3. Plumbing Facilities: Unless otherwise allowed by the Engineer, sanitary facilities in the existing structures shall be operational at all times for plant operating personnel. All other building plumbing systems such as roof and floor drains, pumping, etc., shall be maintained for all structures.
4. Building Heating and Ventilating: Building heating and ventilating for the existing plant structures shall be in service for the entire construction period. Additional temporary heating and ventilation shall be provided as required to maintain facilities under construction adequately heated and vented. The temperatures to be maintained in any areas occupied by plant operating personnel such as offices, lunchrooms, locker rooms, bathrooms, etc., shall be at least 65°F. The temperatures to be maintained in all other interior plant areas, whether new, existing or temporary, shall be maintained at a minimum of 55°F.
5. Power, Light and Communications Systems (General): Electric Power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which

remain in operation. Individual units may be disconnected as required for replacement, but service shall be available at all times including periods when plant elements are out of service. Shutdown of electrical facilities shall be limited to not more than four (4) hours. The Owner may allow longer outages under conditions determined by the Owner by making use of the existing engine-generator at the plant. All costs associated with operation of the engine-generators shall be paid by the Contractor. The Electrical Contractor shall coordinate shutdowns required with the General Contractor to minimize the total number of shutdowns required to complete construction. Owner's phone service to the plant shall be maintained in continuous operation during construction.

6. Draining Process Pipes and Conduits: The contents of all pipes and conduits to be removed, replaced or relocated (or dewatered for a specific purpose) shall be transferred to a suitable facility in a manner approved by the Owner through hoses or piping, or by using pumps if hydraulic conditions so require them. The Contractor shall provide the pumps, piping and hoses at no additional cost to the Owner. No uncontrolled spillage of a pipe or conduit shall be permitted. Any spillage, other than potable water, shall be immediately washed down and flushed into the appropriate process flow train. Contractor shall provide pumping as needed to dewater pipes and to remove leakage from isolation valves used for shutdown. Contractor shall make provisions to remove all air from dewatered pipes as pipes are filled prior to returning pipes or conduits to service.
7. Potable Water System: Potable water service shall be maintained in continuous service at all times during construction except for short term interruptions required for tie-ins. Shutdown of the potable water system shall be fully planned and coordinated with the Plant Superintendent and shall be limited to not more than two (2) hours. Existing hydrants within the plant site shall be operational at all times, unless otherwise approved by the Owner.
8. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.
9. Draining Existing Tankage: The contents of all existing tanks and water bearing structures will be facilitated by the Owner through existing piping and controls. Removal of sludge, grit, and other debris will be the responsibility of the Owner. Contractor to provide minimum of thirty (30) days' notice of scheduled need for emptying of existing tanks and water bearing structures to allow Owner sufficient time to facilities dewatering and debris removal. If demolition of structures, yard piping, or controls by the Contractor renders Owner's operations unable to dewater existing tanks or water bearing structures, Contractor shall be responsible for all tank dewatering per the conditions of Paragraph 1.5.B.6.
10. Permit feed required by the City of Wooster will be waived by the City.

C. Overall Construction Sequence:
   1. To coordinate the completion of work and properly assess the interrelation of unit process the General Contractor shall prepare a proposed construction sequence for all demolition and construction on the project. This Construction sequence should be prepared with input from other contractors and subcontractors and provide dates and schedules for the interruption of power and/or flow at each unit process. Consideration shall be given to the Project Requirements under Paragraph 1.3C.b and paragraph 1.4. The construction sequence shall be submitted for review by Engineer and Owner prior to the commencement of construction operations at these facilities.
   2. To assist the General Contractor in the preparation of a construction sequence, the Engineer has outline a general sequence of construction and specific guidelines for select unit processes. This outline is for reference only and the means and methods of demolition and

construction, and all coordination with the Owner, specific trades or disciplines is the sole responsibility of the General Contractor.

3. Select Specific Process Construction Sequence:
   a. Relocation of transformer
      1) Provide and install new transformer vault. Disconnect existing transformer and relocate to new location.
      2) Extend existing conductors and conduits from existing transformer to new location.
      3) Provide conduit, wire and junction boxes as necessary to extend circuit.
   b. T-002: The improvements to T-002 shall be staged to allow for the continuous operation of the Anaerobic Digestion System to maintain suitable treatment of the waste solids:
      1) Removal of biogas piping, and biogas cover, center mast, and belt support system.
      2) Demolition of existing mechanical mixing system.
      3) Installation of new jet mixing system
      4) Installation of biogas piping, instruments, blowers and replacement membrane cover.
      5) Upon suitable pressure testing and commissioning, the City will introduce sludge from T-003 into the new unit.
   c. T-003: The improvements to T-003 shall be staged to allow for the continuous operation of the Anaerobic Digestion System to maintain suitable treatment of the waste solids:
      1) Removal of biogas piping, and biogas cover, center mast, and belt support system.
      2) Demolition of existing mechanical mixing system.
      3) Installation of new jet mixing system.
      4) Installation of biogas piping, instruments, blowers, and replacement membrane cover.
      5) Upon suitable pressure testing and commissioning, the City will introduce sludge from T-001 into the new unit.
   d. T-001: The improvements to T-001 shall be staged to allow for the continuous operation of the Anaerobic Digestion System to maintain suitable treatment of the waste solids:
      1) Removal of biogas piping.
      2) Demolition of existing mechanical mixing system.
      3) Installation of concrete pad for FRP pump enclosure.
      4) Installation of new jet mixing system.
      5) Installation of biogas piping, instruments, etc.
   e. Demo existing flare and replace with new flare. Install blower for T-004 for Base Bid. (Remove Blower installation for add alternate pricing.)
   f. Replacement of Gravity Belt Thickener.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary pumps, temporary blowers, temporary bulkhead materials and temporary piping materials used to perform the work described previously under Construction Sequence, shall be

of the General Construction Contractor's choosing, but shall perform the work within the limits of the Contract requirements.

PART 3 – EXECUTION

3.1 PERFORMANCE

A. The means and methods of performing the operations described previously is the sole responsibility of the individual Contractors.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 013300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and other Division 01 specification sections, apply to this section. This section includes:
   1. Submittal procedures.
   2. Proposed products list.
   3. Construction progress schedules.
   4. Schedule of value.
   5. Shop drawings.
   6. Product data.
   7. Samples.
   8. Field samples.
   9. Manufacturers' instructions.
   10. Manufacturers' certificates.
   11. Photographic documentation

B. The term submittal used throughout this section includes shop drawings, samples, manufacturer's product data in the forms of descriptive literature, specifications, and published detail drawings, photographic documentation (photos/videos) and also CONTRACTOR prepared drawings, certified test reports or reports and such other certificates required by the Contract Documents.

1.2 SUBMITTAL PROCEDURES

A. Within two (2) weeks after the award of Contract, submit a progress schedule of submittals to the ENGINEER for review and acceptance indicating the proposed dates of submission and the number for the various types of Work. Arrange submission dates in the proper sequence of the importance of the Work to the progress of construction. Prepare and transmit each submittal sufficiently in advance of performing the related Work or other applicable activities, or within the time specified in the individual Work of other related sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the CONTRACTOR's failure to transmit submittals sufficiently in advance of the Work.

B. Deliver submittals to ENGINEER at address listed in Invitation to Bidders.

C. Transmit each item under ENGINEER-accepted forms. Each transmittal shall be numbered in sequence. Resubmittals are to have original number with an alphabetic suffix (example 1A). Identify Project, CONTRACTOR, subcontractor, major supplier; identify pertinent drawing sheet

and detail number(s). Identify deviations from Contract Documents. Provide space for CONTRACTOR and ENGINEER review stamps.

D. Apply CONTRACTOR's approval stamp, signed, or initialed certifying that review, verification of products required, field dimensions adjacent to construction work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Shop drawings which do not contain the above listed requirement as well as a CONTRACTOR's approval stamp and original signature will not be reviewed by the ENGINEER and will be returned to the CONTRACTOR.

E. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work. Unidentified variations without technical justifications will be rejected.

F. Shop drawings, product data and samples shall only be submitted by the CONTRACTOR. They will not be submitted by subcontractors or suppliers.

G. Comply with progress schedule for submittals related to Work progress. Coordinate submittal of related items.

H. The CONTRACTOR will include five (5) copies of all documents in each submission.

I. After ENGINEER review of submittal, revise and resubmit as required; identify changes made since previous submittal.

J. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.

K. Provide Safety Data Sheets (SDS) for all products and materials.

L. Faxes will not be accepted as shop drawing submittals.

1.3 ELECTRONIC SUBMITTALS

A. Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Name file with submittal number or other unique identifier, including revision identifier.
      a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
   3. Provide means for insertion to permanently record CONTRACTOR's review and approval markings and action taken by ENGINEER.
   4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to OWNER**,** containing the following information:
      a. Project name.
      b. Date.
      c. Name and address of ENGINEER.

d. Name of CONTRACTOR.
e. Name of firm or entity that prepared submittal.
f. Names of subcontractor, manufacturer, and supplier.
g. Category and type of submittal.
h. Submittal purpose and description.
i. Specification Section number and title.
j. Specification paragraph number or drawing designation and generic name for each of multiple items.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number [, numbered consecutively].
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedules and schedule of values in duplicate within fifteen (15) days after date established in notice to proceed. After review by ENGINEER, revise and resubmit as required. Submit revised schedules with each application for payment, reflecting changes since previous submittal.

B. Show projected percentage of completion for each item of Work as of time of each Application for Progress Payment.

C. Show submittal dates required for shop drawings, product data and samples, and product delivery dates.

1.5 SCHEDULE OF VALUE

A. Submit typed Schedule on 8-inch by 11-inch paper; CONTRACTOR’s standard form or media-driven printout will be considered upon request within 21 days after the effective date of the Agreement.

B. Format: The Table of Contents of this document. Identify each line item with number and title of the major specification sections.

C. For unit cost allowances, give quantities measured from Contract Documents multiplied by the unit cost equal to the total for each item.

D. Include in each line item a directly proportional amount of CONTRACTOR’s overhead and profit.

E. Revise schedule to list change orders for each application of payment.

1.6 PROPOSED PRODUCTS LIST

A. Within fifteen (15) days after date of notice to proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Product data includes standard printed information on manufactured products that has not been specially prepared for this Project, including but not limited to the following:
   1. Product specifications and installation instructions.
   2. Standard color charts.
   3. Catalog cuts.

1.7 SHOP DRAWINGS

A. When required, one (1) digital or at least five (5) hard copies of the shop drawings shall be submitted by the CONTRACTOR with such promptness as to avoid delay in the Work. All shop drawings shall be identified with the name of the CONTRACTOR, and numbered in consecutive order. If hard copies are provided, four (4) copies of all shop drawings shall be retained by the ENGINEER. Two (2) additional copies shall be retained by the OWNER.

B. The OWNER will pay for the ENGINEER's review of up to two (2) submittals of each shop drawing. The costs for review of all subsequent submittals of a particular shop drawing shall be borne by the CONTRACTOR, and shall be deducted from the CONTRACTOR's applications for payment.

C. Shop drawings are technical drawings and data that have been specially prepared for this Project, including but not limited to the following:
   1. Fabrication and installation drawings.
   2. Setting diagrams.
   3. Shopwork manufacturing instructions.
   4. Schedules.
   5. CONTRACTOR's engineering calculations.
   6. Shop, setting, fabrication, equipment and/or layout drawings of all structural, piping, equipment and other component materials and facilities proposed to be furnished under this Contract shall be submitted. Said drawings shall show all pertinent dimensions, details, materials of construction, schematic representations, supports, construction methods, field construction criteria, relationship with other adjacent or integral proposed and/or existing facilities, and such other data as required to demonstrate compatibility with the basic design concepts set forth in the Contract Documents. Said drawings may be the product of either the CONTRACTOR, a subcontractor, or a supplier, but, in any event, the CONTRACTOR shall be held responsible for the accuracy and completeness of same and for conformity with the provisions of the plans and specifications. All shop drawings will be to scale.

1.8 PRODUCT DATA

A. Submit the number of copies specified in individual specification sections; if hard copies, four (4) of which will be retained by the ENGINEER and two (2) by the OWNER.

B. Mark each copy to identify applicable products, models, options, and other data; supplement manufacturers' standard data to provide information unique to this Project.

1.9 SAMPLES

A. Submit full range of manufacturers' standard colors, textures, and patterns for OWNER/ENGINEER's selection. Allow four (4) weeks for selection of finishes from time of submission.

B. Submit samples of finishes from the full range of manufacturer's standard colors, textures, and patterns for ENGINEER's selection.

C. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

D. Include identification on each sample with full Project information.

E. Submit the number or samples specified in respective specification section; four (4) will be retained by the ENGINEER and two (2) by the OWNER. Review samples that may be used in the Work are indicated in the specification section.

1.10 FIELD SAMPLES

A. Provide field samples of finishes at Project as required by individual specification sections. Install sample complete and finished. Acceptable samples in place may be retained in completed Work.

1.11 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for product data.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.12 MANUFACTURER'S CERTIFICATES

A. Submit manufacturers' certificate to ENGINEER for review in quantities specified for product data. Utilize the specified equipment warranty and certification form.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to the ENGINEER.

1.13 PHOTOGRAPHIC DOCUMENTATION

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs accompanying each monthly Payment Application.
   3. Final completion construction photographs.

1.14 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of eight (8) megapixels, and at an image resolution of not less than [3200 by 2400] pixels.

B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to ENGINEER.

PART 3 - EXECUTION

3.1 GENERAL

A. When making a submission for review and acceptance, the CONTRACTOR shall do so with the understanding that he is considered to have checked the items in the shop drawing before submitting them and that he is satisfied that, in their present state, they not only meet the requirements of the Contract Documents, but will present no difficulties in erection and completing his Contract, and shall clearly note his approval on all shop drawings prior to their submission to the ENGINEER. Failure of the CONTRACTOR to note his approval will be reason for the ENGINEER to return such submission to the CONTRACTOR unchecked.

B. The review of shop drawings, product data, etc. will be general and shall not relieve the CONTRACTOR from the responsibility for proper fitting and construction of the Work nor from furnishing materials and Work required by the Contract which may not be indicated on the shop drawings when reviewed.

C. At the time of each submission, the CONTRACTOR will, in writing, call the ENGINEER's attention to any deviations that the shop drawing, certification, or sample may have from the requirements of the Contract Documents.

D. The ENGINEER will timely review the submittals and return them to the CONTRACTOR in accordance with Paragraph 6.17.D, provided that the schedule has been received and accepted, but his review and acceptance shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents. The review of a separate item as such will not indicate acceptance of the assembly in which the item functions.

E. No Work requiring a shop drawing, product data certification, or sample submission shall be commenced until the submission has been reviewed and accepted by the ENGINEER. A copy of each shop drawing certification and each sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

F. The ENGINEER's review of shop drawings, product data certifications, or samples shall not relieve the CONTRACTOR from his responsibility for any deviations from the requirements of the Contract Documents unless the CONTRACTOR has, in writing, called the ENGINEER's attention to such deviation at the time of submission and the ENGINEER has given written acceptance to the specific deviation, nor shall any acceptance by the ENGINEER relieve the CONTRACTOR from responsibility for errors or omissions in the shop drawings.

G. The CONTRACTOR shall note that the ENGINEER has not given acceptance to any item of equipment or material prior to submission of shop drawings, certifications, or samples. This applies both to specified and alternate items. Therefore, use of specified items does not remove the necessity to submit for acceptance. The ENGINEER will not give oral or written acceptance to any equipment supplier, materialman, manufacturer's representative or vendor. The ENGINEER will not review or consider any submission prior to the issuing of a notice to proceed and will not consider or review any submission made directly by an equipment supplier, materialman, manufacturer's representative or vendor. Any such submittal will be forwarded to the CONTRACTOR without comment.

H. Where information is submitted which covers a number of variations of the general class of equipment, each such item shall be individually endorsed to describe exactly which parts apply to the equipment being furnished. Such endorsement shall also include the Project name, Contract number and serial number of the particular item covered. Separate sheets of paper bearing this endorsement will not be acceptable unless pasted individually on the rear of each print submitted.

I. At the same time of each submission, the CONTRACTOR shall, in writing, note any deviations that the shop drawing, product data, or sample may have from the requirements of the drawings and specifications. This written notice shall accompany the submission and shall be attached thereto. If it is necessary to convey these deviations on drawings, the information shall appear on the drawing and within the written notice. Acceptance of drawings and data which contain items which deviate from the drawings and specifications, without such written notice, will not constitute acceptance of substitute items. Drawings which are submitted without such written notice will be returned to the CONTRACTOR unmarked if the deviation is detected in the review by the ENGINEER. Acceptance of any equipment item will be withdrawn if such deviations are detected after installation and prior to release of the CONTRACTOR from his contractual obligations, regardless of whether or not drawings covering the equipment item were approved.

J. Once the CONTRACTOR issues a shop drawing, product data or samples for review by the ENGINEER, the CONTRACTOR assumes responsibility for all changes to other trades necessitated by his selection.

K. If in the opinion of the ENGINEER any information is insufficient for proper review, the ENGINEER may elect to request additional information prior to the review of an item.

L. The purpose of having drawings, product data and samples checked and accepted by the ENGINEER is twofold:
1. To assure compliance with the purpose and intent of the specifications.
2. To assist the CONTRACTOR in interpreting the specifications so as to eliminate mistakes in the design or manufacture of equipment actually shipped to the OWNER.

M. The formal acceptance given to the CONTRACTOR is to be considered as in conformance with these purposes and in no manner shall be construed so as to relieve the CONTRACTOR from any liability or responsibility for proper design, fabrication or compliance with the specifications.

N. It is to be understood by the CONTRACTOR that final distribution copies of a previously accepted drawing are not rechecked. It is also to be understood that only those portions requiring change on "Furnish As Corrected" and "Revise And Resubmit" drawings will be rechecked. It is the responsibility of the CONTRACTOR to ensure that any changes made on resubmitted drawings are clearly indicated as a revision to the drawing and called to the ENGINEER’s attention in the transmittal letter.

O. Shop Drawing Action Stamp
1. The ENGINEER’s drawing action stamp will appear on all the CONTRACTOR's drawings returned to him by the ENGINEER. Stamp will indicate acceptance status on each drawing.
2. Acceptance status designation on action stamp is defined as follows:
    a. Reviewed:
        1) Denotes no exception taken but does not act as a guaranty or warranty of CONTRACTOR's design or as a warranty or guaranty of any type on the part of the ENGINEER. The intent is that the CONTRACTOR proceed with all Work shown on the drawing with no exceptions.
    b. Revise and Resubmit:
        1) Denotes that drawing does apply to item specified but shows insufficient detail or has too many errors and omissions. The intent is that the CONTRACTOR should not start fabrication or construction. ENGINEER has marked corrections on drawings.
    c. Furnish as Corrected:
        1) Denotes specific exceptions taken by ENGINEER but does not act as a guaranty or warranty of CONTRACTOR's design or as a warranty or guaranty of any type on the part of the ENGINEER. The intent is that the CONTRACTOR proceed with all Work shown on the drawing as modified or clarified by ENGINEER. Furnish as Corrected could require additional submissions of items that require correction or further clarity, but does not warrant the complete revision of the submittal.
    d. Rejected:
        1) Denotes that drawing is not according to form specified. Either drawing does not apply to item as specified or item shown was not specified. Drawing is poorly prepared and difficult to interpret. The intent is that the CONTRACTOR will submit a new drawing. ENGINEER does not make

corrections on drawing but does tell CONTRACTOR why drawing was "not accepted".

e. Repeated Submissions:

1) CONTRACTOR shall respond to required submittals with complete and accurate information in order to limit submissions to one (1) initial submission and two (2) repeat submissions. Should submissions exceed the three (3) referred to above, beginning with the fourth submission review, the costs to the OWNER involved with such additional submission will be backcharged to the CONTRACTOR by deducting such costs from payment due.

2) In the event the CONTRACTOR requests a substitution for a previously approved item, the costs involved for the reviewing and approval process will also be backcharged to the CONTRACTOR.

P. Any shop drawing, product data certification, or sample which is accepted by the ENGINEER, but which is stamped "Furnish as Corrected" will require the CONTRACTOR to reply in writing stating his agreement to comply with the corrections or notes.

3.2 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to ENGINEER.

D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by ENGINEER.

1. Flag construction limits before taking construction photographs.
2. Take twenty (20) photographs to show existing conditions adjacent to property before starting the Work.
3. Take twenty (20) photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

E. Periodic Construction Photographs: Take twenty (20) photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take twenty (20) color photographs after date of Substantial Completion for submission as project record documents. ENGINEER will inform photographer of desired vantage points.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 014000 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.8 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
2. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION
Not Used.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 014500 – STATEMENT OF SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 SCOPE OF STATEMENT OF SPECIAL INSPECTIONS

A. This section defines the requirements for Special Inspections as required by Section 1704 of the International Building Code (IBC) and any State or local amendments.

B. The Engineer has prepared a Statement of Special Inspections, which identifies the type and extent of required Special Inspections. The Statement of Special Inspections is attached to this Section and is provided for the CONTRACTOR's reference. The CONTRACTOR shall include the cost of Special Inspections in their bid and shall contract with one or more Special Inspections Agencies to perform Special Inspection services if there are tests or requirements beyond those specified in the Contract Documents.

C. The CONTRACTOR shall plan and conduct his operations as to schedule and allow Special Inspections, providing adequate time and safe access for inspections. The Contractor shall coordinate requirements for Special Inspections with the Special Inspections Agency or ENGINEER.

D. Special Inspections shall be in addition to inspections performed by Building Officials that are specified in IBC Section 109.

E. Special Inspections do not supersede other inspections and testing required by the Contract Documents to satisfy the Contractor's quality control responsibility. Contractor shall be responsible for all costs associated with quality control requirements as required by other sections of the Specifications.

F. Special Inspections shall not relieve Contractor's obligation to perform and complete work in accordance with Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.

G. This section does not apply to construction equipment, shoring, earth retention systems, and temporary structures used by the Contractor in construction and not detailed in the Contract Documents. The Contractor shall be solely responsible for means, methods, techniques, sequences, or procedures of construction and any associated building code requirements

1.2 DEFINITIONS

A. Periodic Special Inspections: The part-time or intermittent observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work has been or is being performed and at the completion of the work.

B. Continuous Special Inspections: The full-time observation of work requiring Special Inspection by a Special Inspector who is present in the area where the work is being performed.

C. ENGINEER: The Registered Design Professional in Responsible Charge of each building system. These systems include structural, mechanical, electrical, and architectural components.

D. Special Inspector: Individual employed by or retained by the Special Inspections Agency or ENGINEER who is qualified in inspection of a particular type of construction and conducts inspection activities in that type of construction, as required by this section.

E. Statement of Special Inspections: Document prepared by the ENGINEER and submitted to the Building Official which identifies the type and extent of required Special Inspections.

F. Approved Fabricator: Fabricator who has been registered and approved by the Building Official to perform a particular type of work without Special Inspections.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. Each Contractor responsible for the construction or fabrication of a main wind- or seismic-force-resisting system, designated seismic system, or a wind- or seismic-resisting-component listed in the Statement of Special Inspections shall submit a Statement of Responsibility to the Building Official and Engineer prior to the commencement of work. The Statement of Responsibility shall contain acknowledgement of the special requirements contained in the Statement of Special Inspections.

B. The Contractor shall coordinate requirements of Special Inspections with the Special Inspections Agency and the Special Inspectors and shall provide adequate time and access to conduct inspections. The Contractor is solely responsible for providing safe access and any necessary safety equipment required to conduct inspections. The Special Inspector shall not supervise, direct, control, or have authority over or be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of the Contractor to comply with Laws and Regulations applicable to the performance of the Work.

C. Special Inspections shall not relieve the Contractor's obligation to perform and complete work in accordance with the Contract Documents. Results of Special Inspections activities, including any discrepancies that are noted or not noted, shall never constitute an acceptance of work that is not in accordance with the Contract Documents.

D. The Contractor shall promptly correct any discrepancies noted by the Special Inspectors. Any corrections of discrepancies that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer. Where Engineer approval is required, the Contractor

shall report the discrepancy to the Engineer in accordance with provisions of the General Conditions. The Engineer will authorize any changes to the Contract Documents required for the correction in accordance with provisions of the General Conditions. Copies of all correspondence related to the correction shall be submitted concurrently to the Special Inspections Agency.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Price. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, testing agencies, and authorities having jurisdiction.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. There are no Temporary Facilities for the Engineer included within this Project.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install electric power service overhead, unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install telephone line(s) for each field office.
1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
1. Provide in primary field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 016100 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    a. Form of Approval: As specified in Division 01, Section 013300
    b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section 013300. Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See Divisions 02 through 46 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section 017700

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Engineer's sample", provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied,

Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION

Not Used.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 017300 – EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.
   8. Correction of the Work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.

C. Record Log: Maintain a log of layout control work. Insert special requirements for laying out the Work to suit Project.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
   2. Allow for building movement, including thermal expansion and contraction.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
   1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section 014000.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 017500 – STARTUP AND ADJUSTMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Engineer.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.

d. Project record documents.
e. Identification systems.
f. Warranties and bonds.
g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section 017700.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. This section specifies administrative and procedural requirements for Project closeout, including but not limited to:
   1. Closeout procedures
   2. Final cleaning.
   3. Adjusting.
   4. Project record documents.
   5. Spare parts and maintenance materials.
   6. Repair of the Work.

1.3 CLOSEOUT PROCEDURES

A. Comply with procedures stated in the general conditions of the Contract for issuance of the Certificate of Substantial Completion.

B. When CONTRACTOR considers work has reached final completion, submit written certification that contract documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for ENGINEER's inspection.

C. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a Final Application for Payment and statement of accounting giving total adjusted Contract sum, previous payments, and total remaining due.

D. ENGINEER will issue a final change order reflecting approved adjustments to the Contract total not previously made by a change order.

1.4 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.

Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps. Clean roofs, gutters, downspouts, and drainage systems.

C. Clean site; sweep paved areas, rake clean other surfaces.

D. Remove waste and surplus materials, rubbish, and construction facilities from the project and from the site.

E. Remove all construction debris from tanks, manholes, pits, etc. Do not allow debris to be washed into treatment process or stream.

1.5 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
      a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

1.6 PROJECT RECORD DOCUMENTS

A. See Section 017839

1.7 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Submit one (1) digital set prior to final inspection. Operation and maintenance data shall have been previously approved by the ENGINEER as a part of the acceptance of the equipment.

B. Provide a separate volume for each system, with a table of contents and index tabs for each volume.

C. For each system, give names, addresses, and telephone numbers of suppliers and service representatives. Include the following unless otherwise instructed in the specifications:
1. Appropriate design criteria;
2. List of equipment;
3. Parts list;
4. Operating instructions;
5. Emergency instruction and procedures
6. Maintenance procedures, equipment
7. Maintenance instructions, finishes;
8. Shop drawings and product data; and
9. Warranties.

1.9 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by CONTRACTOR that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of ENGINEER.
   d. Name of CONTRACTOR.
   e. Page number.
4. Submit list of incomplete items in the following format:
   a. MS Excel electronic file. ENGINEER will return annotated file.

1.10 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct OWNER’s designated personnel in operation, adjustment and maintenance of products, equipment and systems, at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.11 WARRANTIES AND BONDS

A. Provide duplicate, notarized copies. Execute CONTRACTOR's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers. Provide table of contents and assemble in binder with durable plastic cover.

B. Submit material prior to Final Application for Payment. For equipment put into use with OWNER's permission during construction, submit within ten (10) days after first operation. For items of work delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as the start of the warranty period.

1.12 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective Work regardless of whether the OWNER has benefited from use of the Work through a portion of its anticipated useful service life.

D. OWNER’s Recourse: Written warranties made to the OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The OWNER reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The OWNER reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer’s disclaimers and limitations on product warranties do not relieve the CONTRACTOR of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the CONTRACTOR.

1.13 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the OWNER.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the OWNER.

1.14 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each section, in addition to that used for construction of work. Coordinate with OWNER, deliver to project site, and obtain receipt prior to final payment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

Not Used.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal:
         1) Submit *one* paper-copy set of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and one of file prints.
         3) Submit record digital data files and one set(s) of plots.
      b. Final Submittal:
         1) Submit *one* paper-copy set of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and *one* set of prints.
         3) Print each drawing, whether or not changes and additional information were recorded.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.

c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Work Change Directive.
   k. Changes made following Engineer's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG, Version, Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Engineer for resolution.
6. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
   a. See Division 01 Section "Submittal Procedures" for requirements related to use of Engineer's digital data files.
   b. Engineer will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

2. Consult Engineer for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Engineer.
   e. Name of Contractor.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION

DIVISION 2 – EXISTING CONDITIONS

SECTION 024000 – DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. This section includes improvements related to Demolition during Construction including:
   1. Demolition of designated building(s), equipment and fixtures.
   2. Demolition of designated process equipment, piping and controls.
   3. Demolition and removal of site improvements adjacent to a building or structure to be demolished.

1.3 SUBMITTALS

A. Project Schedule – Provide a detailed sequence of demolition activities and removal work, with starting and ending dates for each activity. Clearly denote interruptions of utility service to plant and structures, such as electrical, natural gas, etc.

B. Pre-demolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by building demolition operations. Submit before Work begins.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing Local, Commonwealth and Federal notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.5 PROJECT CONDITIONS

A. Demolition work, as specified herein, is not intended to be performed as a total wrecking operation but selective demolition as preparatory work relative to performance of various construction operations in the Project.

B. Existing Conditions:

1. Demolition information shown in the Contract Documents is based on visual field examination and existing record documents. While the information provided is believed to be correct, no assurance is implied relative to its total completeness or accuracy. Report discrepancies to Engineer before disturbing existing installations.
2. The Contractor hereby distinctly agrees that neither the Owner nor the Engineer is responsible for the correctness or sufficiency of the information given and after his own Site Investigation:
    a. That he shall have no claim for delay or extra compensation or damage against the Owner or the Engineer on account of the information given; and
    b. That he shall have no claim for relief from any obligation or responsibility under the Contract with respect to the above stated stipulations.
3. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Owner's use of buildings/structures:
1. Buildings/Structures to be demolished will be vacated and their use discontinued before start of Work according to the Contractor's submitted schedule.
2. Contractor shall provide written notification not less than 72 hours prior to commencement of demolition activities for each unit process.
3. Owner will occupy portions of buildings adjacent to demolition area. Conduct all demolition so Owner's operations will not be disrupted.
4. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
5. Maintain access to existing walkways, exits, and other adjacent occupied or used facilities.

D. Exterior Dust control: To prevent unnecessary spread of dust during performance of exterior demolition work, thoroughly moisten surfaces and debris as required to prevent dust being a nuisance to the public, neighbors and concurrent performance of other work on the site. Water for use in dust control shall be obtained from Contractor's own source.

E. Interior Dust Control: To prevent spread of dust during performance of the interior demolition work, Contractor shall erect and maintain a dust tight temporary enclosure surrounding the areas of demolition. Fabricate such temporary enclosure from impervious materials such as plywood or sheet polyethylene supported on rough carpentry framing.

F. Protection During Demolition: Exercise care during demolition work to confine demolition operations to the areas as indicated on the Drawings. The physical means and methods used for protection are at the contractor's option. However, the contractor will be completely responsible for replacement and restitution work of whatever nature with no additional compensation paid.
1. Additionally, if public safety is endangered during the progress of the demolition work, provide adequate protective measures to protect public pedestrian and vehicular traffic on streets and walkways.
2. Signs, signals and barricades used shall conform to requirements of Federal, State and local laws, rules, regulations, precautions, orders and decrees.

G. Explosives and Blasting: Not permitted in performance of demolition work.

H. Storage or sale of removed items or materials on-site is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials needed or required for temporary protection in the form of barricades, fences, enclosures, etc., may be pre-used construction materials of sound condition and reasonably clean. However, the condition of same materials shall meet or exceed the requirements of governing agencies or approving bodies as may be involved with the work.

B. Equipment, machinery and apparatus, motorized or otherwise, used to perform the demolition work may be used as chosen at the Contractor's discretion, but which will perform the work within the limits of the Contract requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to performance of the actual work, carefully inspect the entire site and locate those objects and structures designated to be demolished and removed. Verify with the Engineer the objects being removed and objects to be preserved.

B. Locate existing exposed and buried active utilities and determine the requirement for their protection, or their disposition with respect to the demolition work.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. If applicable, verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
   3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished. Strengthen or add new supports when required during progress of demolition.

G. Removed and Salvaged Items: Comply with the following:
   1. Clean salvaged items of dirt and demolition debris.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

H. The Owner will remove the liquid (including sludge) from liquid containing structures where work is required.

3.2 DEMOLITION PRACTICES

A. General Requirements: The means and methods of performing demolition and removal operations are the sole responsibility of the Contractor. However, equipment used, and methods of demolition and removal will be subject to approval of the Engineer.
1. Do not use cutting torches until work area is cleared of flammable materials.
2. Maintain portable fire-suppression devices during flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.

C. Abandoned Equipment and Machinery: Existing equipment and machinery in or on the structures, not claimed as salvage by the Owner, shall also become the property of the Contractor and may not be disposed of on the Site but removed and disposed of in a lawful manner, off Site.

D. Salvage: The Owner shall have the right to claim as salvage any items and materials removed under the work of this Section. Should such right of salvage be exercised by the Owner, move and neatly store removed items on the site in a location agreeable to the Owner, in a manner approved by the Engineer. While not intending the following list to be exhaustive and complete, the Owner initially intends to claim the following items:

E. When removing concrete slabs, saw cut such slabs at the limits of removal to assure a smooth, uniform joint with new concrete installation.

F. When removing masonry, remove to the next full-size unit so proper toothing in of new work may be done.

G. Perform removal of masonry and concrete debris, keeping such debris dampened during removal and until outside building.

3.3 REPAIRS AND RESTORATION OF SURFACES

A. General: Promptly repair damage to adjacent construction caused by building demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.4 DISPOSAL OF MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in a PA DEP/EPA-approved landfill.

B. Do not allow demolished materials to accumulate on-site.

C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

D. Burning: Do not burn demolished materials.

3.5 PROTECTION

A. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during demolition and reinstalled in their original locations after demolition operations are complete.

B. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
   3. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, as required. Comply with requirements in Section 015000.
   1. Protect existing site improvements, appurtenances, and landscaping to remain.
   2. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
   3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
   6. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise from occupied portions of adjacent buildings.

END OF SECTION

DIVISION 3 – CONCRETE

SECTION 033000 – CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED REFERENCES

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

1.2 DESCRIPTION OF WORK

A. The Work within this section includes, but is not limited to, the furnishing of all equipment, labor and materials and performing all operations necessary to complete the concrete work as specified in accordance with the specifications, applicable drawings and Contract Documents.

1.3 QUALITY ASSURANCE

A. Reference standards shall be the following:
   1. American Association of State Highway and Transportation Officials (AASHTO).
   2. American Concrete Institute (ACI).
   3. ASTM International (ASTM).
   4. Concrete Reinforcing Steel Institute (CRSI).
   5. U.S. Product Standards (PS).

1.4 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by ENGINEER.

B. Shop Drawings; Reinforcement: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. Samples: Submit samples of materials as requested by ENGINEER including names, sources, and descriptions.

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

E. Material Certificates: Provide material certificates in lieu of material laboratory test reports when permitted by ENGINEER. Materials certificates shall be signed by manufacturer and CONTRACTOR certifying that each material item complies with, or exceeds, specified

requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

F. Concrete Testing Service: Engage a testing laboratory acceptable to ENGINEER to perform material evaluation tests.

G. Materials and installed Work may require testing and retesting at anytime during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at CONTRACTOR'S expense.

1.5 PROJECT CONDITIONS

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

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

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

B. Use plywood complying with PS-1, B-B (Concrete Form) Plywood, Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

C. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

D. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

E. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1½ inches to surface.

F. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A185, welded steel wire fabric.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

D. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

E. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I/II.

B. Use one brand of cement throughout Project, unless otherwise acceptable to ENGINEER.

C. Normal Weight Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source for exposed concrete.

D. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling causing deleterious substances.

E. Water: Potable

F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
1. Air-Mix; Euclid Chemical Co.
2. Sika Aer; Sika Corp.
3. MasterAir Series; Master Builders Solutions
4. Darex AEA or Daravair; W.R. Grace
5. Edoco 2001 or 2002; Edoco Technical Products
6. Air-Tite; Gifford-Hill/American Admixtures

H. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.1 percent chloride ions.

I. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
1. WRDA Hycol; W.R. Grace
2. PSI N; Gifford-Hill/American Admixtures
3. Eucon WR-75; Euclid Chemical Co.
4. Master Pozzolith Series; Master Builders Solutions
5. Plastocrete 160; Sika Chemical Corp.
6. Chemtard; Chem-Masters Corp.

7. Pro-Kete-N; Protex Industries, Inc.

J. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G and containing not more than 0.1 percent chloride ions.

K. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
1. WRDA 19 or Daracem; W.R. Grace
2. PSP; Protex Industries Inc.
3. Super P; Anti-Hydro
4. Sikament; Sika Chemical Corp.
5. Mighty 150; ICI Americas Corp.
6. Eucon 37; Euclid Chemical Co.
7. PSI Super; Gifford-Hill
8. Master Rheobuild 1000 or MasterGlenium Series; Master Builders Solutions

L. Water-Reducing, Nonchloride Accelerator Admixture: ASTM C494, Type E, and containing not more than 0.1 percent chloride ions.

M. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
1. Accelquard 80; Euclid Chemical Co.
2. MasterSet FP 20; Master Builders Solutions
3. Gilco Accelerator; Gifford-Hill/American Admixtures

N. Water-Reducing, Retarding Admixture: ASTM C494, Type D, and containing not more than 0.1 percent chloride ions.

O. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
1. Edoco 20006; Edoco Technical Products
2. MasterSet R Series or MasterSet DELVO Series; Master Builders Solutions
3. Eucon Retarder 75; Euclid Chemical Co.
4. Daratard; W.R. Grace
5. PSI R; Gifford-Hill/American Admixtures
6. Plastiment; Sika Chemical Co.
7. Protard; Protex Industries, Inc.

P. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

2.4 RELATED MATERIALS

A. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

B. Vapor Retarder: Provide vapor-retarder cover over prepared base material where indicated below slabs on grade. Use only materials that are resistant to decay when tested in accordance with ASTM E154, as follows:
1. Polyethylene sheet not less than 8-mils thick.

2. Nonshrink Grout: CRD-C 621, factory premixed grout.

C. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
   1. Nonmetallic:
      a. Set Grout; Master Builders
      b. Sonogrout; Sonneborn-Rexnord
      c. Euco-NS; Euclid Chemical Co.
      d. Supreme; Gifford-Hill/American; Admixtures
      e. Crystex; L & M Const. Chemical Co.
      f. Sure-Grip Grout; Dayton Superior Corp.
      g. Horngrout; A.C. Horn, Inc.
      h. Five Star Grout; U.S. Grout Corp.
   2. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M182, Class 2.
   3. Moisture-Retaining Cover: Polyethylene film, complying with ASTM C171.
   4. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C309, Type I, Class A. Moisture loss not more than 0.055 grams per square centimeter when applied at 200 square feet per gallon.
   5. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following.
      a. Masterseal; Master Builders
      b. A-H 3 Way Sealer; Anti-Hydro Waterproofing Co.
      c. Ecocure; Euclid Chemical Co.
      d. Clear Seal; A.C. Horn, Inc.
      e. Sealco 309; Gifford-Hill/American Admixtures
      f. J-20 Acrylic Cure; Dayton Superior
      g. Spartan-Cote; The Burke Co.
      h. Sealkure; Toch Div. - Carboline
      i. Kure-N-Seal; Sonneborn-Rexnord
      j. Polyclear; Upco Chemical/USM Corp.
      k. L & M Cure; L & M Construction Chemicals
      l. Klearseal; Setcon Industries
      m. LR-152; Protex Industries
      n. Hardtop; Gifford-Hill
   6. Bonding Compound: Polyvinyl acetate or acrylic base.
   7. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Acrylic or Styrene Butadiene:
         1) J-40 Bonding Agent; Dayton Superior Corp.
         2) Everbond; L & M Construction Chemicals
         3) Hornweld; A.C. Horn, Inc.
         4) Sonocrete; Sonneborn-Rexnord
         5) Acrylic Bondcrete; The Burke Co.
         6) SBR Latex; Euclid Chemical Co.
         7) Daraweld C; W.R. Grace
      b. Epoxy Adhesive: ASTM C881, two component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
   8. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
      a. Thiopoxy; W.R. Grace

b. Epoxtite; A.C. Horn, Inc.
c. Edoco 2118 Epoxy Adhesive; Edoco Technical Products
d. Sikadur Hi-Mod; Sika Chemical Corp.
e. Euco Epoxy 452 or 620; Euclid Chemical Co.
f. Patch and Bond Epoxy; The Burke Co.
g. Concresive 1001; Adhesive Engineering Co.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to ENGINEER for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to ENGINEER of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until mixes have been reviewed by ENGINEER.

C. Design mixes to provide normal weight concrete with the following properties:
1. 4,000 pounds per square inch (psi), 28-day compressive strength; W/C ratio: 0.58 maximum (non air-entrained), 0.45 maximum (air-entrained).

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by CONTRACTOR when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to OWNER and as accepted by ENGINEER. Laboratory test data for revised mix design and strength results must be submitted to and accepted by ENGINEER before using in Work.

E. Admixtures: Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.

F. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50°F (10°C).

G. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 5 percent plus or minus 1 percent for concrete structures and slabs exposed to freezing and thawing; other concrete, 2 percent to 4 percent air.

H. Use admixtures for water reducing and set control in strict compliance with manufacturer's directions.

I. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 1 and not more than 3.
3. Concrete containing HRWR admixture (super-plasticizer): Not more than 8 after addition of HRWR to site-verified 2- to 3-inch slump concrete.
4. Other concrete: Not less than 1 inch and not more than 4 inches.

2.6 CONCRETE MIXING

A. Job-Site Mixing: Mix materials for concrete in appropriate drum-type batch machine mixer. For mixers of one cubic yard or smaller capacity, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1½ minutes of mixing time by 15 seconds for each additional cubic yard or fraction thereof.

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

C. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level, and plumb Work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, and recesses to prevent swelling and for easy removal.

E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary

openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Re-tightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR-RETARDER INSTALLATION

A. Following leveling and tamping of granular base for slabs on grade, place vapor-retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal with appropriate tape.

3.4 PLACING REINFORCEMENT

A. Comply with CRSI's recommended practice for placing reinforcing bars, for details and methods of reinforcement placement and supports, and as herein specified.

B. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

D. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

E. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

F. Install welded wire fabric in long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to ENGINEER.

B. Provide keyways at least 1½-inches deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

E. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels not to exceed 15 feet in length and maximum width to length ratio of 1:1.5.

F. Form contraction joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

G. Contraction joints in floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

H. If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

3.6 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

A. Clean reused forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a nonstaining, rust-preventative oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other craftsman to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. Apply temporary protective covering to lower 2 feet of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

C. General: Comply with ACI 304 and as herein specified.

D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

E. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

G. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

I. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

J. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

K. Maintain reinforcing in proper position during concrete placement operations.

L. Cold Weather Placing: Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

M. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C) at point of placement.

N. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

O. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

P. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Q. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is CONTRACTOR'S option.

R. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

S. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.

T. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

3.9 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish Work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding ¼ inches in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin, film-finish coating system.

B. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances.

C. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

D. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with ENGINEER before application.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Start initial curing as soon as freewater has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

D. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

E. Provide moisture curing by following methods.
1. Keep concrete surface continuously wet by covering with water.
2. Continuous water-fog spray.
3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges with 4-inch lap over adjacent absorptive covers.

F. Provide moisture-cover curing as follows:
1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape of adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

G. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by

power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Do not use membrane curing compounds on surfaces that are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, damp-proofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to ENGINEER.

H. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

I. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

J. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

K. Sealer and Dust-proofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.12 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 50 Deg F (10 Deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Form-facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.13 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to ENGINEER.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of Work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and

cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Grout base plates and foundations as indicated, using specified non-shrink grout. Use nonmetallic grout for exposed conditions, unless otherwise indicated.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms when acceptable to ENGINEER.

B. Cut out honeycomb, rock pockets, voids over ¼ inch in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

C. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

D. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of ENGINEER. Surface defects including color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins, and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry pack mortar or precast cement cone plugs secured in place with bonding agent.

E. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

G. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

H. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

I. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to ENGINEER.

J. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least ¾-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

K. Perform structural repairs with prior approval of ENGINEER for method and procedure, using specified epoxy adhesive and mortar.

L. Repair methods not specified above may be used, subject to acceptance of ENGINEER.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The CONTRACTOR will employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete may include the following, as directed by ENGINEER.

C. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.

D. Slump: ASTM C143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

E. Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

F. Concrete Temperature: Test hourly when air temperature is 40°F (4°C) and below, and when 80°F (27°C) and above; and each time a set of compression test specimens made.

G. Compression Test Specimen: ASTM C31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

H. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing, if required.

I. When frequency of testing will provide less than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

J. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

K. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

L. Test results will be reported in writing to ENGINEER and CONTRACTOR within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

M. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

N. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by ENGINEER. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. CONTRACTOR shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

DIVISION 09 - FINISHES

SECTION 099000 – PAINTING AND COATING

PART 1 - GENERAL

1.1 RELATED REFERENCES

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

1.2 DESCRIPTION OF WORK

A. This section includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.

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

C. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

D. Paint exposed surfaces whether or not colors are designated in the corresponding schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the OWNER will select from standard colors or finishes available.

E. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

F. Finished metal surfaces not to be painted include:
1. Anodized aluminum
2. Stainless steel
3. Chromium plate
4. Copper
5. Bronze
6. Brass

G. Operating parts not to be painted include moving parts of operating equipment such as the following:
1. Valve and damper operators
2. Linkages
3. Sensing devices
4. Motor and fan shafts

H. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code- required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

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

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

1.4 QUALITY ASSURANCE

A. Referenced standards shall be the following:
   1. Structural Steel Painting Council (SSPC)

B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

C. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

D. Notify the ENGINEER of problems anticipated using the materials specified.

E. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

F. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equivalent products of other manufacturers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material
   2. Product description (generic classification or binder type)
   3. Federal Specification number, if applicable
   4. Manufacturer's stock number and date of manufacture
   5. Contents by volume, for pigment and vehicle constituents
   6. Thinning instructions
   7. Application instructions
   8. Color name and number

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F (7°C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

C. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 JOB CONDITIONS

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

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

C. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5°F (3°C) above the dew point, or to damp or wet surfaces.

D. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

1.7 EXTRA STOCK

A. Provide a 1-gallon container of each color and surface texture to OWNER. Label each container with color, texture, room locations, and date, in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements. Manufacturers offering products that may be incorporated in the Work include but are not limited to the following:
1. Devoe and Raynolds Co. (Devoe)
2. The Glidden Company (Glidden)
3. Benjamin Moore and Co. (Moore)
4. PPG Industries, Pittsburgh Paints (Pittsburgh)
5. Pratt and Lambert (P & L)
6. The Sherwin-Williams Company (S-W)
7. Koppers

2.2 MASONRY BLOCK FILLER

A. High-Performance Latex Block Filler: Heavy-duty latex block fillers used for filling open textured interior and exterior concrete masonry block before application of top coats:
1. Devoe: 52901 Bloxfil Acrylic Latex Block Filler
2. Glidden: 5317 Ultra-Hide Acrylic Latex Block Filler
3. Moore: Moorecraft Block Filler #145
4. Pittsburgh: 6-7 Latex Masonry Block Filler

5. P & L: Pro-Hide Plus Block Filler
6. S-W: Heavy-Duty Block Filler B42W46

2.3 UNDERCOAT MATERIALS

A. Interior Enamel Undercoat: Ready-mixed enamel for use on the interior as an undercoat over a primer on concrete or masonry under an odorless semigloss enamel:
1. Devoe: 8801 Velour Alkyd Enamel Undercoat
2. Glidden: 4200 Spred Ultra Semi-Gloss Enamel
3. Moore: Moore's Alkyd Enamel Underbody #217
4. Pittsburgh: 6-6 Speedhide Quick-Dry Enamel Undercoater
5. P & L: E6 Enamel Undercoater
6. S-W: Pro-Mar 200 Latex Wall Primer B28W200

2.4 PRIMERS

A. Latex-Based Interior White Primer: Latex-based primer coating used on interior gypsum drywall under a flat latex paint or an alkyd semigloss enamel.
1. Devoe: 50801 Wonder-Tones Latex Primer and Sealer
2. Glidden: 5019 PVA Primer
3. Moore: Moore's Latex Quick-Dry Prime Seal #201
4. Pittsburgh: 6-2 Quick-Dry Latex Primer Sealer
5. P & L: Latex Wall Primer Z30001
6. S-W: Pro-Mar 200 Latex Wall Primer B28W200

B. Synthetic, Rust-Inhibiting Primer: Quick-drying, rust-inhibiting primer for priming ferrous metal on the exterior under full-gloss and flat alkyd enamel and on the interior under flat latex paint or odorless alkyd semigloss or alkyd gloss enamels:
1. Devoe: 14920 Bar-Ox Quick Dry Metal Primer, Red
2. Glidden: 5210 Glid-Guard Universal Fast-Dry Metal Primer
3. Moore: Ironclad Retardo Rust-Inhibitive Paint #163
4. Pittsburgh: 6-208 Red Inhibitive Metal Primer
5. P & L: Effecto Rust-Inhibiting Primer
6. S-W: Kem Kromik Metal Primer B50N2/B50W1

C. Alkyd-Type Zinc Chromate Primer: Primers used for priming ferrous metals on the exterior and interior under high-gloss alkyd enamels.
1. Devoe: 41839 Bar-Ox Zinc Chromate Primer
2. Glidden: 5205 Glid-Guard Tank & Structural Primer
3. Pittsburgh: 6-204 Zinc Chromate Primer
4. P & L: Tech-Gard Zinc Chromate Primer E154
5. S-W: Zinc Chromate Primer B50Y1

D. Galvanized Metal Primer: Primer used to prime interior and exterior zinc-coated (galvanized) metal surfaces:
1. Devoe: 13201 Mirrolac Galvanized Metal Primer
2. Glidden: 5229 Glid-Guard All-Purpose Metal Primer
3. Moore: Ironclad Galvanized Metal Latex Primer #155
4. Pittsburgh: 6-215/216 Speedhide Galvanized Steel Primer

5. S-W: Galvite B50W3

2.5 PAINT MATERIAL

A. Interior Semigloss Odorless Alkyd Enamel: Low-odor, semigloss, alkyd enamel for use over a primer and undercoat on concrete, masonry (including concrete masonry block), plaster, wood, and hardboard and both ferrous and zinc-coated (galvanized) metal surfaces and over a primer on gypsum drywall:
1. Devoe: 26XX Velour Alkyd Semigloss Enamel
2. Glidden: 4200 Spred Ultra Semigloss Enamel
3. Moore: Moore's Satin Impervo Enamel #235
4. Pittsburgh: 27 Line Wallhide Semigloss Enamel
5. P & L: Cellu-Tone Alkyd Satin Enamel
6. S-W: Classic 99 Semigloss Enamel A40 Series

B. Exterior Flat Acrylic Emulsion: For use over a block filler on concrete masonry block surfaces.
1. Devoe: 15XX Wonder-Shield Exterior Acrylic Latex Flat House Paint
2. Glidden: 3535 Spred Glide-On
3. Moore: Moore's Flat Exterior Latex Masonry and House Paint #105
4. Pittsburgh: 72 Line Sun-Proof Acrylic Latex House Paint
5. P & L: Vapex Latex Flat House Paint
6. S-W: A-100 Acrylic Latex Flat Exterior Finish A-6 Series

C. Exterior Alkyd Gloss Enamel: Use over a primer and undercoat on exterior and interior surfaces, wood, and hardboard, and ferrous and zinc-coated metal surfaces:
1. Devoe: 70XX Mirrolac Interior/Exterior Alkyd Gloss Enamel
2. Glidden: 4500 Glid-Guard Industrial Enamel
3. Moore: Impervo High-Gloss Enamel #133
4. Pittsburgh: 54 Line Quick-Dry Enamel
5. P & L: Effecto Enamel
6. S-W: Industrial Enamel B-54 Series

D. Paste Wood Filler: Solvent-based, air-drying, paste-type wood filler for use on open-grain wood on interior wood surfaces:
1. Devoe: 4800 Wonder Woodstain Interior Paste Wood Filler
2. Glidden: Glidden Paste Wood Filler
3. Moore: Benwood Paste Wood Filler
4. Pittsburgh: (none required)
5. S-W: Sher-Wood Fast-Dry Filler

E. Bitumastic Coal Tar Epoxy: No. 300-M, two (2) coats, black for use on exterior concrete below finished grade of wet well and dry well.

F. Interior Concrete Sealer: Tnemec 66 Clear Expoline Reduced 20%, one (1) coat, color to match existing interior concrete color, or in cases of no color, clear sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

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

3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar in-place items that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by craftsmen skilled in the trades involved.

B. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

D. Cementitious Materials: Prepare concrete masonry block surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

E. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.

F. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

G. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

H. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

I. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of SSPC.

J. Touch-up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch-up with the same primer as the shop coat.

K. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants.

L. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

M. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

N. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

O. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.3 APPLICATION

A. All exposed ferrous metals (interior and exterior) require two (2) finish coats of paint over primer.

B. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

D. Paint colors, surface treatments, and finishes are indicated in the corresponding schedules.

E. Provide finish coats that are compatible with primers used.

F. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.

G. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

H. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

I. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

J. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.

K. Sand lightly between each succeeding enamel or varnish coat.

L. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

M. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

N. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

O. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

P. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.

Q. Mechanical items to be painted include but are not limited to:
1. Piping, pipe hangers, and supports
2. Tanks
3. Supports
4. Motors and mechanical equipment
5. Accessory items

R. Electrical items to be painted include but are not limited to:
1. Conduit and fittings

S. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

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

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

3.4 FIELD QUALITY CONTROL

A. The OWNER reserves the right to invoke the following test procedure at any time and as often as the OWNER deems necessary during the period when paint is being applied:

B. The OWNER will engage the services of an independent testing laboratory to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the CONTRACTOR.

C. The testing laboratory will perform appropriate tests for the following characteristics as required by the OWNER:
1. Quantitative materials analysis
2. Abrasion resistance
3. Apparent reflectivity
4. Flexibility
5. Washability
6. Absorption
7. Accelerated weathering
8. Dry opacity
9. Accelerated yellowness
10. Recoating
11. Skinning
12. Color retention
13. Alkali and mildew resistance

D. If test results show material being used does not comply with specified requirements, the CONTRACTOR may be directed to stop painting, remove non-complying paint, pay for testing, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

3.5 CLEANING

A. Clean-Up: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect Work of other trades whether to be painted or not against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. Provide "WET PAINT" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

C. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINT SCHEDULE:

A. General: Provide the following paint systems for the various substrates, as indicated.

B. Concrete Masonry Units:
   1. Semigloss Alkyd Enamel Finish: Two (2) coats over filled surface with total dry film thickness not less than 3.5 mils, excluding filler coat.
      a. Block Filler: High-Performance Latex Block Filler
      b. Undercoat: Interior Enamel Undercoat (FS TT-E-543)
      c. Finish Coat: Interior Semigloss Odorless Alkyd Enamel (FS TT-E-509)

C. Woodwork:
   1. Semigloss Enamel Finish: Three (3) coats.
      a. Undercoat: Interior Enamel Undercoat (FS TT-E-543)
      b. First Coat: Interior Semigloss Odorless Alkyd Enamel (FS TT-E-509)
      c. Second Coat: Interior Semigloss Odorless Alkyd Enamel (FS TT-E-509)

D. Ferrous Metal:
   1. Full-Gloss Enamel Finish: Two (2) coats over primer with total dry film thickness not less than 2.5 mils.
      a. Primer: Synthetic Rust-Inhibiting Primer (FS TT-P-664)
      b. Undercoat: Interior Enamel Undercoat (FS TT-E-543)
      c. Finish Coat: Exterior Alkyd Gloss Enamel (FS TT-E-506)

E. Zinc-Coated Metal:
   1. Full-Gloss Enamel Finish: Two (2) coats over primer with total dry film thickness not less than 2.5 mils.
      a. Primer: Galvanized Metal Primer (FS TT-P-641)
      b. Undercoat: Interior Enamel Undercoat (FS TT-E-543)
      c. Finish Coat: Exterior Alkyd Gloss Enamel (FS TT-E-506)

END OF SECTION

DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 133423 – FIBERGLASS BUILDINGS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes freestanding, shop fabricated fiberglass reinforced plastic (FRP) enclosure for the T-001, Dry Pit Chopper pump including the following:
   1. Doors and Frames
   2. Electrical
   3. Lighting
   4. HVAC

B. Related Sections include the following:
   1. Division 3 Section "Cast-in-Place Concrete" for concrete foundations, slabs, and anchor-bolt installation.
   2. Division 9 painting Sections for finish painting of shop-primed structural framing.
   3. Division 26 electrical

1.3 REFERENCES

A. ASTM E 72 - Standard Test Method of Conducting Strength Tests of Panels for Building Construction

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM C 582 - Standard Specification for Contact Molded Reinforced Thermosetting Plastic (FRP) Laminates for Corrosion-Resistant Equipment

D. American Society of Civil Engineers (ASCE):
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

E. Building Officials Code Administrators International (BOCA).

F. FM Global.

G. International Business Code (IBC).

H. Universal Building Code (UBC).

1.4 SYSTEM DESCRIPTION

A. Overall Outside Dimensions:
1. Length: 12’
2. Width: 10’
3. Eave and Wall Height: 8’ (minimum)

B. Buildings shall conform to dimensions shown on Drawings.

C. Waterproof, airtight, corrosion resistant, chemical resistant, lightweight, and environmentally aesthetic.

D. Code Requirements:
1. UBC.
2. BOCA.
3. State and local authorities having jurisdiction.
4. Local authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following Fiberglass Building components:
1. Construction details, material descriptions, dimension of individual components and profiles, and finishes
2. Preparation instructions and recommendations
3. Installation Methods
4. Electrical
5. HVAC
6. Doors.
7. Windows.
8. Accessories.

B. Shop Drawings: For the following fiberglass building system components. Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer registered in PA responsible for their preparation.
2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
3. Show roof-mounted items including equipment supports, pipe supports and penetrations, lighting fixtures, and snow guards.
4. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
5. Show wall penetrations as noted within drawings.

C. Product Certificates: For each type of metal building system, signed by product manufacturer.
1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
a. Name and location of Project.

b. Order number.
c. Name of manufacturer.
d. Name of Contractor.
e. Building dimensions including width, length, height, and roof slope.
f. Governing building code and year of edition.
g. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
h. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
i. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Warranties: Special warranties specified in this Section.

E. Other Action Submittals:
1. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
2. Wall Penetrations

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing FRP prefabricated structures with a minimum documented experience of five years.

B. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

C. Prefabricated Components: Comply with manufacturer's published literature for products meeting indicated design loads in accordance with state and local requirements as applicable.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Shrink-wrap the completed structure or building components with protective plastic for shipment to and storage at the job site.
1. Support structure for shipment and handling to prevent warping and fracturing.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect all components and accessories from corrosion, deformation, damage and deterioration when stored at job site. Keep materials free from dirt and foreign matter.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 COORDINATION

A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

B. Coordinate installation of equipment supports and wall penetrations, which are specified in the drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturer:
1. Warminster Fiber Glass
2. Shelter Works
3. Mekco, Newton WI
4. Or Equal

2.2 PERFORMANCE REQUIREMENTS

A. Cooperate with regulatory agency or authority and provide data as requested by authority having jurisdiction.

B. Prefabricated structures and shelters specified herein shall be handicapped accessible in accordance with ICC/ANSI A117.1 and other state and local requirements as applicable.

C. Design to sustain superimposed loads for load combinations in accordance with ASCE 7 and as applicable at the location of the project.

D. Design to withstand effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Determine loads based on the following minimum requirements:
a. Dead load of building.
b. Mechanical equipment.
c. Uniform pressure of 40 lbf per sq ft (1.92 kPa), acting inward or outward (standard).
d. Uniform pressure as indicated on Drawings.
e. Wind Load: Buildings: 120 mph (193.1 kph) (2000 IBC Exp. C).
f. Wind Load: Shelters: 90 mph (144.8 kph).
g. Wind Load: As indicated on Drawings.
h. Snow Load: Buildings and Shelters; 40 lbf per sq ft (1.92 kPa).
i. Snow Load: Buildings and Shelters;30 lbf per sq ft (1.44 kPa).
j. Snow Load: As indicated on Drawings.
k. Live Load: Meet requirements of local authorities having jurisdiction.
l. Live Load: As indicated on Drawings.
2. Stresses produced by specified load conditions shall be determined consistent with recognized methods of analysis.

E. Energy Code: Meet energy code requirements for state where structure resides.

F. Seismic Performance: Capable of withstanding effects of earthquake motions according to ASCE 7 - Minimum Design Loads for Buildings and Other Structures: Section 9 - Earthquake Loads.

G. Average R Value of Assembled Building: R14.

H. Electrical Devices: Devices UL listed with wiring bearing UL classification and conforming to the current NEC.

I. HVAC: equipment to be rated for at least 6 ACPH and 0.2 kw of heat load from equipment.

2.3 MATERIALS

A. Resin:
   1. COR61-AA-545 Resin as manufactured by Interplastic Corporation. or equivalent.

B. Gel Coat: Isophthalic NPG, UV- stable, chalk resistant.
   1. Manufacturer: LHM-2900 Low Hap White HydroShield LITE, NPG/ISO Marine Gel Coat as manufactured and supplied by HK Research Corporation or equivalent.
   2. Color: White high gloss

C. Glass Fiber Reinforcing: Type E glass and treated with finish compatible to resin being used.
   1. Glass Fiber Chopped Roving: Manufactured by PPG, Owens Corning, or equivalent. Used for making random fibers 1-1/4 inch (32 mm) in length.
   2. Stitch Mat: Type CM-2415 or CDM-2415 manufactured by BTI, Knytex, or equivalent.

D. Insulation: Ridged polyisocyanurate urethane foam designed for permanent thermal insulation.
   1. Functional Temperature Range: Minus 300 to 300 degrees F (Minus 184.4 to 148.9 degrees C).
   2. Thickness: 2 inches (51 mm).

2.4 FIBERGLASS REINFORCED PLSATIC (FRP) PANELS

A. Wall and Roof Building Panels: High gloss molded to desired structural architectural shapes.
   1. Uninsulated FRP Laminate Panels: 3/16 inch (5 mm) thick.
      a. Isophthalic NPG Exterior Gel Coat: 18 mils (0.457 mm) minimum.
      b. Glass Fiber Chopped Roving: 1-1/4 inch (32 mm) random fiber (minimum glass content to be 35 percent by weight.
      c. Polyester structural laminating resin.
   2. Insulated FRP Laminate Panels: Two, 1/8 inch (3 mm) thick skins sandwiching a core of insulation.
      a. Isophthalic NPG Exterior Gel Coat: 18 mils (0.457 mm) minimum.
      b. Glass Fiber Chopped Roving: 1-1/4 inch (32 mm) random fiber (minimum glass content to be 35 percent by weight.
      c. Polyester structural laminating resin.
      d. Core Insulation: Solid polyisocyanurate urethane insulation.
   3. Panel Flanges: Minimum 1/4-inch (6 mm) FRP laminate.
   4. Perimeter Anchoring Flanges: 1/4 inch (6 mm) minimum thickness FRP laminates.

a. One layer of stitch mat laminated within the anchoring flange.

B. FRP Panel Properties:
1. Barcol Hardness: 35 minimum.
2. Laminates with Stitch Mat and Random Chopped Fibers Warp Direction: Minimum values.
a. Tensile Strength: 61,400 psi (423338.1 kPa).
b. Tensile Modulus: 2.98 msi (20.54 gPa).
c. Compressive Strength: 44,500 psi (306816.7 kPa).
d. Compressive Modulus: 2.28 msi (15.72 gPa).
e. Flexural Strength: 73,700 psi (508143.6 kPa).
f. Flexural Modulus: 2.35 msi (16.20 gPa).
g. Laminates with Random Chopped Fibers: Minimum values.
h. Tensile Strength: 12,500 psi (86184.5 kPa).
i. Tensile Modulus: 1.1 msi (7.58 gPa).
j. Compressive Strength: 22,700 psi (156511 kPa).
k. Compressive Modulus: 1.04 msi (7.17 gPa).
l. Flexural Strength: 23,800 psi (164095.2 KPa).
m. Flexural Modulus: 0.97 msi (6.69 gPa).

C. Fabrication:
1. Form individual segments on high gloss molds ensuring consistent dimensions of finished parts. Cast each segment in one piece.
2. Laminate shall consist of alternating layers of stitch mat and/or chopped roving impregnated with resin.
3. Form panel flanges and perimeter anchoring flanges to the interior of the building.
4. Insulation: Bonded to interior and exterior laminate with resin.
a. Panels without a continuous and consistent bond between insulation and laminate are not acceptable.
5. Install wall penetrations prior to shipment. Details provided in drawings.
6. Interior Finish: White corrosion resistant FRP.
7. Exterior Finish: White high gloss molded gel coat

2.5 DOOR AND FRAME MATERIALS

A. Doors and Frames (Grade II - Economy): FRP.
1. Manufacturer: FRP Doors and Frames shall be as manufactured by Plyco Corp., P.O. Box 386, Elkhart Lake, WI 53020; Tel: 800-558-5895; www.plyco.com.
2. Double panel 6068.
3. Insulated between two FRP door panel skins.
4. Plyco Series 98FG
5. Hardware: Heavy-duty stainless steel.
6. Triple Butt Hinges: 4-1/2 x 4-1/2 inch (102 x 102 mm).
7. Closer/Hold Open Devices: Pneumatic.
8. Inactive Leaf: Top and bottom bolts.
9. Weather stripping.
10. Seals: Threshold and header.
11. Rain drip edge.
12. Commercial lockset.

2.6 WINDOWS

1. Windows: Fixed windows and one slider with insect screen and positive locking device.
2. Windows: Additional fixed windows.
3. Windows: Additional horizontal sliding windows.
4. Windows: Vertical Sliding Windows.
5. Windows: One Cashier Window.
6. Windows: As indicated on Drawings.
7. Glazing: See Section 08 83 13 - Mirrored Glass Glazing.
8. Glazing: 1/4 inch (6 mm) thick, clear tempered safety glass.
9. Glazing: 3/4 inch (19 mm) thick, insulated, clear tempered safety glass.
10. Glazing: 1/4 inch (6 mm) thick, clear polycarbonate.
11. Glazing: With tint.
12. Glazing Tint: Grey.
13. Glazing Tint: Bronze.
14. Glazing Tint: Green.
15. Glazing Tint: As indicated on Drawings.
16. Glazing: Low E.
17. Glazing: Ballistic protection as specified.
18. Glazing: As indicated on Drawings.

2.7 MISCELLANEOUS MATERIALS

A. Connection of Building Panels:
   1. Permanently fused building assembly yielding a watertight one-piece structure.

B. Wall Penetrations as indicated within Drawings

C. Louvers: As specified in the appropriate Division 05 Section.

D. Base Gasket:
   1. Soft, closed cell, neoprene foam gasket material.
   2. Suitable for exposure to weather conditions at building location.
   3. Suitable for exposure to sewage and sewage gases.
   4. Thickness: 3/8-inch (9 mm) minimum.

2.8 ELECTRICAL SERVICE

A. Panelboard
   1. NEMA 1 208/120V three-phase load center with minimum 50A main circuit breaker and branch circuit breakers as required for lighting, HVAC and receptacle circuits.

B. Electrical Wiring and Conduits:
   1. Nonmetallic Conduit:
      a. PVC: Rigid nonmetallic conduit, EPC-40 per NEMA TC 2 and UL 651.
   2. Conduit and wiring shall be installed in accordance with the most recent National Electrical Code (NEC).
   3. Minimum #12 AWG shall be used for wiring.
   4. Wiring shall not be loaded above 60-degree C temperature rating.

2.9 LIGHTING

A. Indoor Lighting Fixtures:
   1. Ceiling-mounted LED light fixtures providing an average of 50 foot-candles on the floor area.
   2. Interior lights to be operated by (1) single-pole switch with weatherproof cover.

2.10 HVAC

A. Project Requirements:
   1. Provide 6 Air Changes Per Hour Ventilation
   2. Heat Load of Equipment within Building – 0.2 kW

B. Heating Unit: Wall-mounted and thermostatically controlled. Electric heater with fan-forced operation. Enclose heater in enameled steel cabinet. Sized to meet Project requirements.
   1. Unit shall be rated for 208V three-phase operation

C. Louvers: Extruded Aluminum Louvers with Insect Screens as manufactured and supplied by Sunvent Industries. Sized to meet Project requirements.

D. Gravity Intake Damper with Insect Screen. Sized to meet Project requirements.
   1. FRP.

E. Shutter Wall Mounted Exhaust Fan. Sized to meet Project requirements
   1. FRP.

2.11 CONVENIENCE OUTLET

A. One NEMA 5-20R GFCI duplex receptacle with weatherproof-when-not-in-use cover.

2.12 ASSEMBLY

A. Shop assemble complete building.
   1. Flanges between adjacent panels shall be factory bonded together with methyl methacrylate.
   2. Seal exterior edges of adjacent panels with color matched silicon sealant.

B. Fit and bond appurtenances, formed separately, into openings cut in finished panel or integrally mold into panel. Bond attachments with glass fibers and resin from interior of panel.

C. Resin seal cut all drilled edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting foundations for compliance with manufacturer's requirements, including installation tolerances and other conditions affecting performance of supporting members.

B. Check installed anchor bolts for accuracy. Verify that bearing surfaces are ready to receive the work.

C. Verify the rough-in of required mechanical and electrical services prior to placement of the structure.

3.2 PREPARATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Clean surfaces thoroughly prior to installation.

D. Commencement of installation constitutes acceptance of conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install continuous neoprene gasket between perimeter anchoring flange and where panels rest on supporting structure.

C. Resin seal cut all drilled edges.

D. Repair damaged panels.

E. Minimum spacing and edge distances of concrete anchors shall conform to requirements of Section 055000 - Metal Fabrications.

F. Place on prepared concrete foundations and slabs provided as specified under Section 033000 - Cast-in-Place Concrete.

G. Anchor securely in place, allowing for required movement, including expansion and contraction.

H. Connect mechanical services per manufacturers’ recommendations.

I. Connect electrical services as specified in Division 26.

3.4 PROTECTION

A. Protect installed buildings until completion of project.

B. Touch-up, repair or replace damaged items before Substantial Completion.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260510 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to provide basic electrical materials in accordance with the plans and as specified herein.

B. This section includes limited scope general construction materials and methods for application with electrical installations as follows:
   1. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
   2. Miscellaneous metals for support of electrical materials and equipment.
   3. Nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
   4. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
   5. Concrete used for the following:
      a. Housekeeping pads.
      b. Pipe supports.
      c. Filling in box outs in floor slabs, after conduit installation.
      d. Pole foundations.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with basic electrical materials in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein. Where provisions of the pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
   1. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings."
   2. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
   3. National Electrical Code (NEC)

B. Qualifications
   1. Installer Qualifications. Engage an experienced Installer for the installation and application of joint sealers.
   2. Qualify welding processes and welding operators in accordance with American Welding Society (AWS) D1.1 "Structural Welding Code -Steel."
      a. Certify that each welder has satisfactorily passed AWS qualification tests

for welding processes involved and, if pertinent, has undergone recertification.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following:
1. Product data for joint sealers.
2. Shop drawings detailing fabrication and installation for metal fabrications and wood supports and anchorage for electrical materials and equipment.
3. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.
4. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this section.

1.4 JOB CONDITIONS

A. Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instruction for multicomponent materials.

B. Store and handle joint sealer materials in compliance with the manufacturer’s recommendations to prevent their deterioration and damage.

1.6 DEFINITIONS

A. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation at the direction of the Engineer until suitable bearing materials are reached.

B. Subbase as used in this section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.

C. Subgrade as used in this section refers to the compacted soil immediately below the slab or pavement system.

D. Unauthorized excavation as used in this section consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Miscellaneous Metals and Reinforcing Materials

1. Provide steel plates, shapes, bars, and bar grating conforming to ASTM A 36.
2. Provide cold-formed steel tubing conforming to ASTM A 500.
3. Provide hot-rolled steel tubing conforming to ASTM A 501.
4. Provide steel pipe conforming to ASTM A 53, Schedule 40, welded.
5. Provide non-shrink, non-metallic grout which is pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout, recommended for interior and exterior applications.
6. Provide fasteners which are zinc-coated, type, grade, and class as required.
7. Provide deformed reinforcing bars conforming to ASTM A615, Grade 40 or 60, unless otherwise indicated.
8. Provide reinforcing materials with size and placement as shown on the plans.
9. Provide welded wire fabric conforming to ASTM A185

B. Miscellaneous Lumber

1. Provide framing materials that are Standard Grade, light framing size lumber of any species. Number 3 Common or Standard Grade boards complying with West Coast Lumber Inspection Bureau (WCLIB) or American Wood Preservers Association (AWPA) rules, or Number 3 boards complying with Southern Pine Inspection Bureau (SPIB) rules. Lumber shall be preservative treated in accordance with AWPA LP-2, and kiln dried to a moisture content of not more than 19 percent.
2. Provide construction panels which are plywood panels; American Plywood Association (APA) C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inch.

C. Joint Sealers

1. Provide joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Provide colors as selected by the A/E from manufacturer's standard colors.
3. Provide the following types of elastomeric joint sealers:
   a. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates, formulated with fungicide, intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
4. Provide fire-resistant watertight joint sealers which are two-part, foamed-in-place, silicone sealant formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by UL, or other testing and inspection agency acceptable to

authorities having jurisdiction. Material shall be a closed-cell, non-adhering material.

D. Concrete: Provide concrete as specified in Division 03 – Concrete.

2.2 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
   1. One Part, Mildew-Resistant, Silicone Sealant
      a. "Dow Corning 786," Dow Corning Corp.
      b. "SCS 1702 Sanitary," General Electric Co.
      c. "863 #345 White," Pecora Corp.
      d. "Proglaze White," Tremco Corp.
      e. "OmniPlus," Sonneborn Building Products Div.
   2. Fire Resistant Joint Sealers
      a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
      b. "Pensil 851," General Electric Co.

PART 3 – EXECUTION

3.1 COORDINATION

A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Field-verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and regulations, the contract documents, and the referenced standards.

C. The work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for proper installation, this work shall be carefully done, and any drainage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the Engineer in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. Preparation for Joint Sealers
   1. Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 EXCAVATION

A. Comply with the applicable requirements of Division 31 – Earthwork.

B. For the excavation of underground vaults and electrical structures conform to elevations and dimensions shown within a tolerance of +0.10 foot and extending a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, area within drip line or large trees. Protect the root system from drainage and drying out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement or precast concrete is placed.

C. Excavate trenches for electrical installation as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.
2. Excavate trenches to depth indicated or required.
3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.

D. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

E. Where subsidence occurs at electrical installation excavation during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.4 INSTALLATION

A. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
2. Provide field welding which complies with AWS "Structural Welding Code."

B. Erection of Wood Supports and Anchorage
1. Cut, fit, and place nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

C. Application of Joint Sealers
1. Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
2. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
3. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
4. Install firestopping sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency. Use dams to obtain proper sealing.

D. Installation of Housekeeping Pads
1. Strength, spacing, and placement of equipment housekeeping pads. Provide a housekeeping pad for all floor-mounted equipment, unless noted otherwise. Fabricate pad as follows:
   a. Coordinate size of housekeeping pad with actual equipment provided. Fabricate base 4 inches larger in both directions than the overall dimensions of the supported equipment.
   b. Form concrete pads with framing lumber treated with form release compounds. Provide 1-inch chamfer on top edge and corners of pad.
   c. Install reinforcing bars and place anchor bolts and sleeves to facilitate securing equipment.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260519 – WIRES, CABLES AND CONNECTORS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the plans and as specified herein.

B. Miscellaneous: This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with wires, cables, and connectors in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
   1. National Protection Association (NFPA) 70, National Electrical Code (NEC).
   2. Underwriters' Laboratories, Inc. (UL) Compliance. Provide components which are listed and labeled by UL under the following standards.
      a. UL Standard 83Thermoplastic Insulated Wires and Cables.
      b. UL Standard 486AWire Connectors and Soldering Lugs for Use with Copper Conductors.
      c. UL Standard 854 Service Entrance Cable.
   3. National Electrical Manufacturers Association/lnsulated Cable Engineers Association (NEMA/ICEA) Compliance. Provide components which comply with the following standards:
      a. WC-5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
      b. WC-7 Cross-Linked Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
      c. WC-8 Ethylene Propylene Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   4. Institute of Electrical and Electronic Engineers (IEEE) Compliance. Provide components which comply with the following standards:
      a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors.

B. Regulatory Requirements: Comply with provisions of the following code and conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submittals: Submit the following:
1. Product data for electrical wires, cables, and connectors.
2. Product data for Megger insulation testing instrument.
3. Report sheets for Megger testing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable properly packaged in factory-fabricated-type containers or wound on NEMA specified type wire and cable reels.

B. Store wire and cable in clean, dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. Handle wire and cable carefully to avoid abrading, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Wires and Cables
1. Provide electrical wires and cables of manufacturer's standard materials as indicated by published product information designed and constructed as recommended by manufacturer for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20 deg C (68 deg F).
2. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:
a. Provide Type XHHW for dry locations, maximum operating temperature 90 deg C (194 deg F). Insulation, flame-retardant, cross-linked polyethylene; conductor, annealed copper.

b. Provide Type THWN for dry and wet locations; maximum operating temperature 75 deg C (167 deg F). Insulation, moisture and heat-resistant, flame-retardant thermoplastic; conductor, annealed copper.

3. Provide color coding for phase identification in accordance with requirements in Division 26 Section “Electrical Identification”.

4. Conductor stranding, unless otherwise noted, shall be as follows:

AWG	kcmil	Strands
No. 14 (control)		7
No. 12 to No. 10		1
No. 8 to No. 2		7
No. 1 to No. 4/0		19
	250 and above	37

B. Connectors and Terminals

1. General: Provide UL-type factory-fabricated metal connectors and terminals of sizes, ampacity ratings, materials, types, and classes indicated.
2. Twist-on Connectors: Conforming to UL 486 C, consisting of a tapered spring with insulated outer covering.
3. Compression Connectors: Tin-plated copper. Configuration shall be tee, in-line, etc., as required.
4. Terminals: Tin-plated copper, compression locking fork tongue with insulated barrel.
5. Compression Lugs: Tin-plated copper, standard barrel, one-hole or two-hole as required.
6. Heat-Shrink Insulation: Heat-shrinkable polyolefin with an internally applied adhesive watertight sealant.
7. Motor Connection Kit: Consisting of compression lugs bolted together, cloth tape cover, and heat-shrink insulation.
8. Splice Kit: Consisting of compression connector and heat-shrink insulation.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Wire and Cable

a. American Insulated Wire Corp.
b. Brintec Corp.
c. Carol Cable Co., Inc.
d. Senator Wire and Cable Co.
e. Southwire Company.
f. Or equivalent.

2. Connectors and Terminals for Wires and Cable Conductors
   a. AMP.
   b. Burndy Corporation.
   c. Ideal Industries, Inc.
   d. 3M Company.
   e. O-Z/Gedney Co.
   f. Raychem.
   g. Thomas and Betts Corp.
   h. or equivalent.

PART 3 – EXECUTION

3.1 WIRE AND CABLE INSTALLATION

A. Uses Permitted
   1. Install UL Type RHW or XHHW cable for power feeders, motor branch circuits, panelboard feeder circuits, and below grade or exterior control and metering circuits.
   2. Install UL Type THWN, THW, or XHHW wiring in conduit, for branch circuits for lighting, receptacles, and interior control and metering circuits.
   3. Install UL Type MTW wiring interior to instrument and control panels. Conductors shall be stranded with at least 19 strands in the conductor.

B. Install electrical cables, wires, and connectors in compliance with NEC.

C. Coordinate cable installation with other work.

D. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL-listed pulling compound or lubricant, where necessary.

E. Use pulling means, including fish tape, cable, rope, and basketweave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

F. Conceal all cable in finished spaces.

G. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

H. Power conductors shall be No. 12 AWG minimum. Control conductors may be No. 14 AWG where circuit amperes and the NEC allow and when length does not pose a voltage drop problem.

I. Conductors shall be sized such that voltage drop does not exceed 3% for branch circuits or 5% for feeder/branch circuit combination.

J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

3.2 CONNECTOR, TERMINAL, AND SPLICE INSTALLATION

A. Uses Permitted
1. Install twist-on connectors for lighting, communication, and receptacle branch circuits and utilization equipment only in size No. 8 AWG and smaller and only in finished areas.
2. Install forked-tongue terminals on control and metering conductors which connect to terminal blocks.
3. Install motor connection kits on all polyphase induction motors.
4. Install compression connectors and lugs for all other connections.

B. Use splice and tap connectors which are compatible with conductor material.

C. Install all compression connectors, splices, and lugs with a racheting tool which will not release until proper compression is achieved.

D. Install splices which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.

E. Service entrance conductors shall be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.

F. All splices shall be made only by specific permission of the A/E, and then only in manholes or pullboxes, and shall be sealed watertight with a heat-shrink insulation.

G. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated,

tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.3 FIELD QUALITY CONTROL

A. The Contractor shall test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

B. The Contractor shall test by Megger Test, the insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits:
1. Motor Control Center.
2. Panelboard.
3. Switchboards.
4. Switchgear.
5. Motors.

C. The Megger Testing shall be witnessed by the A/E. The A/E shall be notified at least 48 hours in advance of testing.

D. Measure the insulation resistance at 500 volts dc with a hand-cranked or motor-driven "Megger" insulation testing instrument. Battery-operated test instruments are not permitted. All test instruments are to be provided by the Contractor.

E. If any insulation resistance measures less than 50 megohms, the cable shall be considered faulty with the cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

F. Any cable which fails the insulation tests or which fails when tested under full load conditions shall be replaced with new cable for the full length and retested. Corrective action and repeated tests shall be accomplished at the Contractor's own expense.

G. Maintain testing report sheets identifying each cable tested, what each feeder or motor branch circuit will be connected to, and the level of insulation resistance measured. Test reports shall be signed by the tester, initialed by the A/E and sent to the A/E within 48 hours.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260526 – GROUNDING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK.

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install grounding materials in accordance with the Contract Drawings and as specified herein.

B. Grounding: This section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this section may be supplemented in other sections of these Specifications.

C. Applications of electrical grounding and bonding work in this section include the following:
1. Underground metal piping.
2. Underground metal and steel reinforced concrete structures.
3. Electrical power systems.
4. Grounding electrodes.
5. Counterpoise loops.
6. Separately derived systems.
7. Raceways.
8. Service equipment.
9. Enclosures.
10. Equipment.
11. Lighting standards.
12. Isolated signal ground.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work to furnish and install grounding in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with the Contract Drawings and as specified herein.
1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and National Electrical Code (NEC) as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment. Use of conduit system for ground conductor shall not be allowed.
2. Underwriters' Laboratories, Inc. (UL) Compliance: Comply with applicable requirements of UL Standards Nos. 467, "Grounding and Bonding Equipment", and 869 "Reference Standard for Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors". Provide grounding and bonding products which are UL listed and labeled for their intended usage.

3. Institute of Electrical and Electronic Engineers (IEEE) Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submittals: Submit the following:
1. Product data for ground rods, connectors and connection materials, and grounding fittings. Field testing organization certificate, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.
2. Report of field tests and observations certified by the testing organization.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver ground wire properly packaged in factory fabricated type containers or wound on NEMA specified type wire reels.

B. Handle grounding wire carefully to avoid abrasing, puncturing and tearing wire insulation. Ensure that dielectric resistance of the cable is maintained.

C. Store grounding materials and ground wire in clean dry space in original containers. Protect products from weather damaging fumes, construction debris, and traffic.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Grounding and Bonding Products
1. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
2. Conductor Materials: Copper

B. Wire and Cable Conductors
1. General: Comply with Division 26 Section “Wires, Cables and Connectors”. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
2. Isolated Ground and Direct Current Low Level Signal Grounding Conductors: Green insulated.
3. Equipment Grounding Conductor
a. Minimum ground wire size for power circuits shall be No. 12 AWG, except where otherwise noted. Wire size No. 8 AWG and larger shall be

stranded, and all smaller wires shall be solid, except where otherwise noted.

b. Minimum ground wire size for control circuits shall be No. 14 AWG, except where otherwise noted.

c. All wire sizes shown on Plan Drawings, Details, and Sketches are based on insulated copper wire based on 60 deg C for circuits 125 amperes and less, and the use of 75 deg C for higher ampere rated circuits.

d. Conductors for grounding system shall be soft or medium hard drawn, stranded, bare copper, except where otherwise noted.

4. All conductors buried in ground shall be bare.
5. Conductors for grounding grid and connection of equipment or other item to grounding grid shall be #2/0 AWG minimum.
6. Grounding Electrode Conductor: Stranded cable
7. Bare Copper Conductors: Conform to the following:
   a. Solid Conductors: ASTM B-3.
   b. Assembly of Stranded Conductors: ASTM B-8.
   c. Tinned Conductors: ASTM B-33.

C. Identification of Ground Conductors
1. Ground conductors shall have conductor identification.
2. Ground conductor identification shall be as called for in the National Electric Code, where covered.
3. Ground conductors larger than No. 6 AWG may be identified by taped color coding at all splices and terminations.
4. Ground conductors No. 6 AWG and smaller shall be color coded.
5. Ground conductor color coding shall be green throughout.
6. Wire markers made of paper tape shall not be used.

D. Miscellaneous Conductors
1. Ground Bus: Bare annealed copper bars of rectangular cross section with 98 percent conductivity, rigidly attach to structure. Use standoff insulated attachment for isolated and low-level DC Systems.
2. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.
3. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated.

E. Connector Products
1. General: Listed and labeled as grounding connectors for the materials used.
2. Pressure Connectors: High conductivity plated units.
3. Bolted Clamps: Heavy duty units listed for the application.
4. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

F. Grounding Electrodes
1. Ground Rods: Copper clad steel with high strength steel core and electrolytic grade copper outer sheath, molten welded to core.
   a. Size: 3/4 inch by 10 feet.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:
1. Anixter Bros., Inc.
2. Bashlin Industries, Inc.
3. Buckingham Mfg. Co.
4. A.B. Chance Co.
5. Dossert Corp.
6. Engineered Products Co.
7. Erico Products, Inc.
8. Galvan Industries, Inc.
9. GB Electrical, Inc.
10. General Machine Products Co., Inc.
11. Hastings Fiber Glass Products, Inc.
12. Ideal Industries, Inc.
13. Kearney-National.
14. McGill Mfg.
15. O-Z/Gedney Co.
16. Raco, Inc.
17. Thomas & Betts Corp.
18. W.H. Salisbury & Co.
19. Utilco Co.

B. Exothermic Weld Connections
1. Cadweld.
2. Therm-O-Weld.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General
1. Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.
2. Ground Rods: Locate a minimum of one rod length from each other and at least the same distance from any other grounding electrode. Interconnect all ground rods with bare conductors buried at least 24 inches below grade. Connect bare cable ground conductors to ground rods by means of exothermic welds. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 2'-6" below finished floor or final grade except as otherwise indicated.
3. Metallic Water Service Pipe: Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around

dielectric fittings. Bond the ground conductor conduit to the conductor at each end.

4. Braided Type Bonding Jumpers: Install to connect ground clamps on meter piping to bypass meters electrically. Use elsewhere for flexible bonding and grounding connections.
5. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
6. Test Wells: Locate as indicated and fabricate in accordance with details indicated.
7. Conductors for grounding grid and connection of equipment or other item to grounding grid shall be #2/0 bare copper AWG minimum.
8. Provide ground rods and ground grid at service entrance equipment as required.
9. Provide an individual ground rod for the neutral of all single phase, 3-wire and 3-phase, 4-wire transformers.
10. Connect neutral of each transformer to cold water pipe.
11. All ground rods shall be driven into undisturbed earth so that the top of the rod is a minimum of 2'-6" below finished grade.
12. All underground grounding conductors shall be a minimum of 2'-6" below grade.
13. Provide a ground wire in all feeder circuits.
14. Provide a ground wire in all branch circuit conduits.
15. Where grounding conductors are subject to mechanical injury, they shall be protected by encasement in concrete or installed in a rigid schedule 80 PVC raceway.
16. All connection of ground conductors to ground rods, bus bars, structural members, pipes, or fences and splices of ground conductors shall be made by exothermic welds, except where otherwise noted.
    a. All connections to bar lugs shall be exothermic weld or compression type.
    b. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in equipment by the Manufacturer.
    c. Prior to the installation of any exothermic weld on connector, all connecting surfaces shall be thoroughly cleaned in accordance with the Manufacturer's recommendations.
    d. Failure to thoroughly clean connecting surfaces shall constitute justifiable ground to require the Contractor to remove and re-install all similar connections at no expense to the Owner or ENGINEER.
17. The Contractor shall not allow or cause any connection or splice for the grounding system to be covered up or enclosed until it has been inspected and approved by the Inspecting Authority.
    a. Any connection or splice that is covered up or enclosed before such inspection and approval shall be uncovered at the Contractor's expense.
    b. After it has been inspected and approved, the Contractor shall cover up or enclose the connection or splice it at his own expense.
18. The resistance to ground for the entire grounding system shall not exceed 25 ohms under normal dry conditions. Tests of grounding resistance shall not be made within 24 hr after a rainfall. If, after testing the system, it is found that the

resistance exceeds the specified value, the Contractor shall install the necessary number of ground rods to reduce the resistance to less than the specified value.

B. Connections

1. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   a. Use electroplated or hot tin coated materials to assure high conductivity and make contact points closer in order of galvanic series.
   b. Make connections with clean bare metal at points of contact.
   c. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
2. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
3. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
4. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
5. Connections at Test Wells: Use compression type connectors on conductors and make bolted and clamped type connections between conductors and ground rods.
6. Compression Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
7. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

C. Underground Distribution System Grounding

1. Manholes, Handholes, and Underground Pullboxes: Install a driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a No. 1 AWG bare tinned copper conductor from the ground rod into the manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure sensitive

tape or heat shrunk insulating sleeve from 2 inches above to 6 inches below the concrete. Seal floor opening with waterproof nonshrink grout.

2. Connections at Manholes, Handholes, and Underground Pullboxes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to the ground rod or ground conductor. Connect circuit ground wire to ground rod. Make connections with minimum No. 4 AWG stranded hard drawn copper wire. Train conductors plumb or level around corners and fasten to manhole or handhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits.
3. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

D. Isolated Signal Ground: Where shown on plan, provide a minimum No. 2 AWG stranded, tinned, insulated ground conductor from each control panel or remote I/O panel to a designated system ground point. Ground conductor shall be routed in 3/4 inch Schedule 80 PVC conduit from panel location to system ground connection point. Terminate ground conductor at an insulated, isolated ground bus and at system ground point. Connection at ground rods shall be via exothermic welds.

3.2 APPLICATION

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Use of conduit system for ground conductor shall not be allowed.
1. Install separate insulated equipment grounding conductors with circuit conductors for feeders and branch circuits and locations where required by code.
2. Computer Panel Circuits: Install separate insulated equipment ground wire in branch circuits from computer area power panels.
3. Instrumentation, Digital Control: Install separate insulated equipment ground conductor in all instrumentation, digital control circuits.
4. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways unless they are designated for telephone or data cables.
5. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct mounted electrical devices operating at 120 volts and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.

B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.

C. Signal and Communications: For telephone, alarm, and communication systems, provide a No. 4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.

D. Separately derived systems required by NEC to be grounded shall be grounded in accordance with NEC paragraph 250-30.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260529 – SUPPORTING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install supporting devices in accordance with the plans and as specified herein.

B. Supports: Types of supports, anchors, sleeves and seals specified in this section include the following:
1. Clevis hangers.
2. Riser clamps.
3. C-clamps.
4. I-beam clamps.
5. One-hole conduit straps.
6. Two-hole conduit straps.
7. Round steel rods.
8. Lead expansion anchors.
9. Toggle bolts.
10. Wall and floor seals.
11. U-channel strut system.

C. Supports, anchors, sleeves and seals furnished as part of factory fabricated equipment, are specified as part of that equipment assembly in other divisions and Division 26 sections.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. National Electrical Code (NEC) Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.
2. Manufacturer's Standardization Society (MSS) Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.
3. National Electrical Contractors Association (NECA) Compliance: Comply with NECA's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
4. Underwriters' Laboratories, Inc. (UL) Compliance: Provide electrical components which are UL listed and labeled.

5. Federal Specification (FS) Compliance: Comply with FS FF-S-760 pertaining to retaining straps for conduit, pipe and cable.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following:
1. Product data for the U-channel strut system.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver supporting devices properly packaged in factory fabricated type container.

B. Store supporting devices in clean dry space in original containers. Protect products from weather damaging fumes, construction debris and traffic.

C. Handle supporting devices carefully to avoid damage.

PART 2 – PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated for the types of areas as defined on the Contract Drawings; and having the following construction features:
1. Clevis Hangers: For supporting conduit; with 1/2-inch diameter hole for round steel rod.
2. Riser Clamps: For supporting conduit; with two bolts and nuts.
3. Reducing Couplings: Steel rod reducing coupling, 1/2-inch x 5/8-inch; galvanized steel.
4. C-Clamps: Malleable iron; 1/2-inch rod size.
5. I-Beam Clamps: Galvanized steel or PVC coated Galvanized steel, 1-1/4-inch x 3/16-inch stock, 3/8-inch cross bolt; flange width 2 inches.
6. One Hole Conduit Straps: For supporting conduit.
7. Two Hole Conduit Straps: For supporting conduit; 3/4-inch strap width; and 2-1/8 inches between center of screw holes.
8. Hexagon Nuts: For 1/2-inch rod size.

9. Round Steel Rod: Galvanized steel; 1/2-inch diameter.
10. Offset Conduit Clamps: For supporting conduit.

C. Conduit Seals: Provide factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide a cast-in-place water stop wall sleeve with a mechanical pipe seal between the conduit and the sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
1. Acceptable Manufacturers:
a. Link Seal.
b. Or Equal.

2.2 ANCHORS

A. Provide anchors of types, sizes and materials indicated; and having the following construction features:
1. Lead Expansion Anchors: 1/2 inch.
2. Toggle Bolts: Springhead; 3/16-inch x 4 inch.
3. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for rigid metal conduit; conduit size, wire type and count as indicated; construct body of malleable iron casting with hot dip galvanized finish.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering supports and anchors which may be incorporated in the work include the following:
a. Ackerman Johnson Fastening Systems Inc.
b. Ideal Industries, Inc.
c. Joslyn Manufacturing and Supply Co.
d. McGraw Edison Co.
e. Rawlplug Co. Inc.
f. Star Expansion Co.
g. U.S. Expansion Bolt Co.
h. Or equivalent.

2.3 U-CHANNEL STRUT SYSTEMS

A. Provide U-channel strut system for supporting electrical equipment, 12-gauge hot dip galvanized steel, of types and sizes indicated; construct with 9/16 inch diameter holes, 8 inch o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:
1. Fixture hangers.
2. Channel hangers.
3. End caps.
4. Beam clamps.
5. Wiring stud.

6. Rigid conduit clamps.
7. Conduit hangers.
8. U-bolts.

B. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:
1. B-Line Systems, Inc.
2. OZ/Gedney Div.; General Signal Corp.
3. Unistrut Div.; GTE Products Corp.
4. GS Metals Corp.; Globes Strut

PART 3 – EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

D. Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for the interior of conduits which penetrate exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260533 – RACEWAYS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to provide raceways in accordance with the plans and as specified herein.

B. Miscellaneous: Types of raceways specified in this section include the following:
1. Rigid metal conduit.
2. Rigid, non-metallic conduit.
3. Liquid-tight flexible non-metallic conduit.
4. Wireways.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. National Electrical Manufacturers Association (NEMA) Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.
2. Underwriters' Laboratories (UL) Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled. Provide listed fire resistance ratings for joint sealers as applicable in accordance with American Society for Testing and Materials (ASTM) E814.
3. National Electrical Code (NEC) Compliance: Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.
4. National Fire Protection Association (NFPA) Compliance: Comply with applicable requirements of NFPA standards relating to fire ratings of wall, floors, and ceilings penetrated by conduits.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submittals: Submit the following:
1. Provide product data for each type of the following products:
a. Raceway and fittings.

b. Wireway and fittings.

2. Provide manufacturer's written installation instructions for wireway, metallic raceway, and non-metallic raceway products.

PART 2 – PRODUCTS

2.1 METAL CONDUIT

A. General: Provide metal conduit of types, grades, sizes, and weights (wall thicknesses) for each service area as indicated on the Contract Drawings. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

B. Rigid Steel Conduit: Provide rigid steel, hot-dip galvanized, threaded-type conforming to FS WW-C-581E, ANSI C80.1 and UL 6.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. AFC.
2. Alflex Corp.
3. Allied Tube and Conduit.
4. Electri-Flex Company.
5. TV Steel Tubular Products Co.
6. Triangle PWC, Inc.
7. VAW of America Inc.
8. Wheatland Tube Co.
9. Or equivalent.

2.2 NONMETALLIC CONDUIT

A. General: Provide non-metallic conduit of types, sizes, and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements which comply with provisions of NEC for raceways.

B. Rigid Nonmetallic Conduit: Schedule 40, 90 C, UL-rated, construct of PVC and conforming to NEMA TC-2, for direct burial, or normal above-ground use, UL-listed and in conformity with NEC Article 347.

C. Liquid-Tight Flexible Non-Metallic Conduit: Continuous spiral of hard PVC encapsulated with flexible PVC.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Cantex Industries.

2. Carlon.
3. Cole Flex-Corp.
4. Electric-Flex.
5. Or equivalent.

2.3 CONDUIT FITTINGS AND ACCESSORIES

A. General: Provide conduit accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

B. Conduit Bodies: Provide galvanized cast metal conduit bodies of types, shapes, and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded conduit entrance ends, removable covers, either cast or of galvanized steel, and corrosion resistant screws.

C. Locknuts: Construct locknuts for securing conduit to enclosures with sharp edge for digging into metal and ridged outside circumference for proper fastening.

D. Bushings: Bushings for terminating conduits smaller than 1-1/4 inch are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Bushings for terminating conduits 1-1/4 inch and larger shall have flared bottom and ribbed sides and shall have a phenolic insulating ring molded into the bushing. All bushings shall have a screw type grounding terminal.

E. Conduit Hubs: Provide conduit hub assemblies complete with hub, locknut, and bushings.

F. Rigid Metal Conduit Fittings: Provide cast malleable iron, galvanized or cadmium-plated fittings conforming to FS W-F-408. Fittings for use with PVC-coated rigid steel conduit shall also be PVC coated identical to the conduit.

G. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp-type.
   1. Straight Terminal Connectors: One-piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
   2. 45-Degree or 90-Degree Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

H. Rigid Non-Metallic Conduit Fittings: NEMA TC 3, mate and match to conduit type and material.

I. Liquidtight Flexible Non-Metallic Conduit Fittings: PVC, one-piece body with PVC ferrule and neoprene gasket.

J. Sealing Fittings and Products
1. Provide mechanical pipe seals as specified in Division 26 Section “Supporting Devices”.
2. Provide joint sealants as specified in Division 26 Section “Basic Electrical Materials and Methods”.
3. Provide gland-type sealing bushings for interior conduit seals as specified in Division 26 Section “Supporting Devices”.

K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering conduit and conduit accessories which may be incorporated in the work include the following:
1. Adalet/PLM.
2. Appleton Electric.
3. Carlon Div. of Indian Head.
4. Condux International, Inc.
5. Crouse-Hinds.
6. Electri-Flex Company.
7. Killark Electric Mfg. Co.
8. O.Z. Gedney.
9. Unistrut Corp.
10. Or equivalent.

2.4 WIREWAYS

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.

B. General Purpose Wireways: NEMA 1 steel, front-accessible, totally enclosed with bolted covers. Finish with rust-inhibiting coating and gray baked enamel finish. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

C. Oil-Tight Wireways: NEMA 12, oil-tight and dust-tight, steel with hinged gasketed cover, external latches and flanged gasketed joints. Finished with gray enamel paint inside and outside.

D. Watertight Wireways: NEMA 4X, watertight, corrosion-resistant stainless steel with hinged gasketed cover, screw clamps and flanged gasketed joints.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering wireways which may be incorporated in the work include the following:
   1. American Electric.
   2. B-Line Systems, Inc.
   3. Hoffman Engineering Co.
   4. Square D Company.
   5. Or equivalent.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify ENGINEER in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.2 COORDINATION

A. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

3.3 INSTALLATION – GENERAL

A. Complete the installation of raceways before starting installation of cables and wires in raceways. All spare raceways shall be capped or plugged and include a pull wire. All metallic raceways shall be grounded.

B. Install raceways as indicated in accordance with manufacturer's written installation instructions, and in compliance with NEC, and National Electrical Contractors Association (NECA) "Standards of Installation." Use roughing-in dimensions furnished by the supplier for all electrically operated units. Set raceways and boxes for connection to units only after the dimensions and locations clear with other trades. Install units plumb and level, and maintain manufacturer's recommended clearances.

C. Mechanically assemble metal raceways for conductors to form continuous electrical conductor, and make connections to electrical boxes, fittings, and cabinets to provide effective electrical continuity and a rigid mechanical assembly. Avoid the use of dissimilar metals throughout the system to eliminate the possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion-inhibiting compound before assembling.

3.4 INSTALLATION – CONDUITS

A. Size conduits to meet the NEC requirements; however, no conduit shall be smaller than 3/4 inch for interior applications or 1 inch for exterior applications. The diameter of embedded conduits shall not exceed one-third of the slab or wall thickness. Conduit shall be embedded in slabs only where specifically shown on plan.

B. Uses Permitted
   1. Use flexible metal conduit in movable partitions and from outlet boxes to recessed lighting fixtures (4-foot minimum and 6-foot maximum length).
   2. Use liquidtight flexible non-metallic conduit for the final 24 inches of connections to motors or control items subject to movement or vibration, and in cells of precast concrete panels for conduits 4 inches and smaller.

C. Preparation
   1. General: Field-bend conduit with benders designed for the purpose so as not to distort or vary the internal diameter. Cut conduits straight and properly ream.
   2. Metal Conduits: Cut conduit threads deep and clean. Use of running threads at conduit joints and terminations is prohibited. Conduits installed underground, in slabs, or exterior shall have threads painted with a corrosion-inhibiting compound before couplings are assembled.
   3. Non-Metallic Conduits: All PVC conduit joints shall be solvent-welded to provide a watertight seal capable of sustaining a hydrostatic pressure of 25 pounds per square inch (psi) for 12 hours. PVC conduit shall be installed in a sand bed except PVC conduit encased in concrete.
   4. Install joint sealers as specified in Division 26 Section “Basic Electrical Materials and Methods”.
   5. Install mechanical pipe seals as specified in Division 26 Section “Supporting Devices”.

D. Routing
   1. General: Install exposed conduits and conduits above suspended ceilings, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or side walls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
   2. Finished Areas: Conduits installed in finished areas of new construction shall be concealed in walls, below or in slabs, or above suspended ceilings.
   3. Concrete Slabs: Conduits in concrete slabs (where shown on plan only) shall be placed between the bottom and top reinforcing steel. Separate conduits by not

less than the diameter of the largest conduit to ensure proper concrete bond. Conduits crossing in the slab must be reviewed by the ENGINEER for proper cover.

4. Other Interior Areas: Conduits shall not be embedded in waterproofed or waterbearing walls. Where possible, conduits to motors or equipment more than 3 feet from walls shall be run in or under the slab and stubbed up to the junction box. For all other interior applications, conduits shall be installed, exposed, or concealed as indicated on the plans.
5. Exterior: Do not run conduits exposed on the exterior surface of buildings.
6. Underground: Install underground conduits a minimum of 24 inches below finished grade for circuits 600 volts or less and 36 inches for circuits above 600 volts. All underground conduits in roadway and parking areas shall be concrete-encased, unless specifically shown otherwise. Concrete-encased conduits shall have a minimum of 3 inches of concrete cover for circuits 600 volts and less and 4 inches for circuits above 600 volts. Wherever possible, make changes of direction with long sweep bends having a minimum radius of 2.5 feet. Conduits shall slope toward manholes or pullboxes and away from building with a pitch of not less than 3 inches in 100 feet. All trenches under roads, walkways, and drives shall be backfilled with compacted granular material to subbase. Conduits passing through backfilled areas shall be supported. Provide a metal-backed yellow polyethylene marker tape in the trench overall conduit runs. Provide spacers for multiple conduit runs.

E. Penetrations

1. Exterior Walls: Conduits penetrating exterior walls of any structure (other than handholes, manholes, or pullboxes) below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal as described in Division 26 Section “Supporting Devices”. As close as practical to the penetration, install a junction box to allow for the installation of the interior conduit seal. The interior conduit seal shall be a gland-type sealing, bushing, or RTV closed-cell silicone foam. Ensure that conduits do not retain water against these seals.
2. Fire-Rated Walls: Conduits penetrating fire-rated walls, floors, and partitions shall be sealed with a fire-rated sealant as described in Division 26 Section “Basic Electrical Materials and Methods”.
3. Roofs: Conduits shall penetrate roofs only where specifically shown on the plans and shall be coordinated with Division 07 of the Specifications. Provide all required flashing.
4. Supports: All conduits must be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the conduit system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1-1/4 inches and 8 feet for conduits 1-1/4 inches and larger. Support riser conduits at each floor level with clamp

hangers. Set conduit anchors in waterbearing or waterproofed walls with waterproof cement. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precasted separators and heavy gauge wire ties or other approved fasteners.

F. Fittings: Install miscellaneous fittings, such as reducers, chase nipples, three-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install grounding-type expansion fittings in raceways every 200 feet of linear run or wherever structural joints are crossed to allow for expansion and contraction. Draw up couplings and conduit sufficiently tight to ensure watertightness. Fasten conduit terminations to NEMA 1 and NEMA 12 enclosures with two locknuts, one inside and one outside, and terminate with a bushing. Fasten conduit terminations to NEMA 3R, NEMA 4, and NEMA 4X enclosures and weatherproof equipment enclosures with conduit hub assemblies.

G. Cleaning: During construction, protect partially completed raceway runs from entrance of dirt, moisture, and debris by means of suitable factory-made duct plugs. After completion of installation, pull a mandrel through every conduit to check for alignment and clear passage. Use an iron shot mandrel with a diameter of 1/4 inch less than the nominal size of the conduit and with a length equal to the conduit diameter. The mandrel shall have a leather or rubber gasket slightly larger than the conduit opening. After testing the conduits with the mandrel, pull a stiff brush through each duct until it is clear of any particles of earth, sand, or gravel, then install plugs until wire is to be pulled. Clean existing ducts to be used for new cable in the same manner as noted above.

3.5 INSTALLATION – WIREWAYS

A. Uses Permitted
1. Use watertight wireways in damp or wet interior areas and for all exterior areas.
2. Use oiltight wireways in dry process areas.
3. Use general purpose wireways in non-process areas.

B. Routing: Install wireways parallel or perpendicular to wall, floors, ceilings, or structural members.

C. Supports: All wireways must be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the wireway system to ventilation ducts. Properly support and anchor wireways for their entire length by structural materials. Wireways shall not span any space unsupported. Set wireway anchors on waterbearing or waterproofed walls with waterproof cement.

D. Fittings: Install fittings that have been specifically designed and manufactured for their particular application.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260543 – MANHOLES, HANDHOLES, AND UNDERGROUND PULL BOXES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to install manholes and handholes in accordance with the plans and as specified herein.

B. Underground Work: This section includes underground electrical work including the following:
Handholes.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with manholes and handholes in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. Manufacturer Qualifications: Manufacturers of precast manholes and handholes shall be firms regularly engaged in manufacturing factory-fabricated manholes and handholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and material certification as required.

B. Submittals: Submit product data for accessories for handholes and covers.

1.4 JOB CONDITIONS

A. Existing Utilities: Information on underground utilities and possible obstructions in the path of construction under this section was obtained through investigations during the design of the project. This information is not intended as representations or warranties of accuracy regarding conditions and locations. The Owner will assume no responsibility of interpretations or conclusions drawn from this information.

1.5 DEFINITIONS

A. Manhole: A below-the-surface enclosure or chamber, large enough for a person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

B. Handhole: A below-the-surface enclosure in connection with ducts into which people reach, but do not enter, for the purpose of installing, operating, or maintaining equipment or wiring.

C. Underground Pull Box: A below-the-surface bottomless enclosure in connection with ducts into which people reach, but do not enter, for the purpose of installing, operating, or maintaining equipment or wiring.

1.6 SEQUENCING AND SCHEDULING

A. Coordination of the Work: Coordinate layout and installation of manholes and handholes with final arrangement of ducts as influenced by actual final location of other utilities in the field. Coordinate elevations of duct and raceway entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to manholes and handholes and as approved by the ENGINEER.

PART 2 – PRODUCTS

2.1 UNDERGROUND PULL BOXES

A. Underground pull boxes shall be factory-fabricated of fiberglass-reinforced polymer concrete. Boxes shall be stackable with minimum dimensions as indicated on the drawings.

B. Covers: Provide heavy-duty covers rated for a service load as indicated on the drawings.

C. Openings: Openings shall be provided for duct number and size as indicated on plan.

D. Underground pull boxes shall be Quazite type "PG" or equal.

E. Raceway/Duct Sealing Compound: Compound shall be non-hardening, putty-like consistency, workable at temperatures as low as 35 deg F. Compound shall not slump at a temperature of 300 deg F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets,

insulation materials, and the common metals. Compound shall have no injurious effect on worker's hands and on materials.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Duct Entrances to Manholes and Handholes: End bells spaced approximately 10 inches center to center for 5-inch ducts and varied proportionately for other duct sizes. The change from regular spacing to end bell spacing shall start 10 feet from the end bell and shall be made without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole and handhole walls from both sides to provide watertight entrances.

B. General: Determine final grading of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing handholes. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

3.2 INSTALLATION OF HANDHOLES

A. Support units on a minimum 4-inch-deep level bed of crushed stone or gravel, graded from the 1-inch sieve to the No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Compact backfill as required to set units securely in place. Backfill and grading shall be sloped to drain surface water away from access covers.

3.3 FIELD TESTING

A. Grounding: Test grounding provisions to ensure electrical continuity of bonding and grounding connections. Make ground resistance test at each ground rod and submit a report of the results. Use an instrument specifically designed for ground resistance measurements.

B. Watertightness: Make internal inspection of manholes/handholes 3 months after completion of construction for indications of water ingress. Where leakage is noted, remove any water found and seal leakage sources. Reinspect after 2 months and reseal any remaining leakage sources. Repeat process at 2-month intervals until leakage is corrected.

3.4 CLEANING AND RESTORATION

A. Clean Manholes: Clean all internal surfaces of manholes, including sump. Remove all foreign material.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260553 – ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to perform the work in accordance with the plans and as specified herein.

B. This section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including, but not limited to, the following:
   1. Buried electrical line warnings.
   2. Identification labeling for raceways, cables, and conductors.
   3. Operational instruction signs.
   4. Warning and caution signs.
   5. Equipment labels and signs.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with electrical identification in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.

B. Electrical Component Standard: Components and installation shall comply with National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."

C. American National Standards Institute (ANSI) Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems", with regard to type and size of lettering for raceway and cable labels.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required

B. Submit product data for each type of product specified.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Underground Line Marking Tape: Permanent, bright colored, continuous printed, metal backed plastic tape compounded for direct burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.

B. Wire/Cable Designation Tape Markers: Vinyl or vinyl cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letters.

C. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/8 inch minimum thick. Engraved legend in black letters on white face and punched for mechanical fasteners.

D. Baked Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

E. Exterior Metal Backed Butyrate Warning and Caution Signs: Weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.

F. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

G. Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 50 deg. F to 350 deg. F. Provide ties in specified colors when used for color coding.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include the following:
1. American Labelmark Co.
2. Calpico, Inc.
3. Cole-Flex Corp.
4. Emed Co., Inc.
5. George-Ingraham Corp.
6. Ideal Industries, Inc.
7. Kraftbilt.
8. LEM Products, Inc.
9. Markal Corp.

10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W. H. Brady, Co.
16. Or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Identify Junction, Pull, and Connection Boxes: Code required caution sign for boxes shall be pressure sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

E. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

F. Line Markers: Install line marker for underground wiring, both direct buried and in raceway.

G. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows.

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange*
Blue	C	Yellow
White	Neutral	White
Green	Ground	Green

*Where not permitted by inspecting authority, use purple.

1. Use conductors with color factory applied the entire length of the conductors. The following field applied color-coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG:
   a. Apply colored, pressure sensitive plastic tape in half lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use l inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

H. Raceway Identification
   1. Cable trays shall have engraved 4-inch x 5-inch nameplates indicating voltage, phase, and circuits. Nameplates shall be spaced every 80 feet or portion thereof. Color coding shall be as specified above.
   2. Conduits shall be identified using manufacturer's standard preprinted, plastic conduit markers extending 360 deg. around conduit. Markers shall be pretensioned snap-on type. Provide 8-inch nominal length. Color coding shall be safety orange background with black letters. Marker shall indicate voltage for power conduits, and length and function for signal, telecommunications, and data conduits. Each conduit shall be marked every 80 feet or portion thereof.

I. Power Circuit Identification: Securely fasten identifying marker to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch letter and number stamps with legend to correspond with designations on drawings.

J. Tag or label conductors as follows:
   1. Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.

2. Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three circuit, four wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communications/signal wiring, use color coding for wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

K. Apply warning, caution, instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

L. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), black lettering in white field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment:
    a. Panelboards, electrical cabinets, and enclosures.
    b. Electrical switchgear and switchboard compartments.
    c. Motor control center compartments.
    d. Motor starters.
    e. Power transfer equipment.
    f. Contactors.
    g. Transformers.
    h. Power generating units.
    i. Telephone switching and termination equipment.
    j. Fire alarm master station or control panel.
    k. Individual compartments in switchgear, switchboards, and motor control centers.
    l. Enclosed circuit breakers.
    m. Disconnect switches.
    n. Control panels.
    o. Each control panel component.

p. Provide single line of text with 1/4-inch-high lettering on a 5/8 inch label (1 inch high where two lines are required) on the following:
   1) Push button stations.
   2) Remote controlled switches.
   3) Dimmers.
   4) Control devices.
   5) Light switches.

M. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

N. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

O. Each switchboard, MCC, substation, major control panel, major telecommunication panel shall, in addition to individual compartment nameplates, have a 4-inch x 5-inch master engraved nameplate indicating equipment designation, voltage, phase, ampacity, and year installed. Color coding shall be same as above.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262200 – TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install transformers in accordance with the plans and as specified herein.

B. Work of this Section includes, but is not limited to:
   1. Dry-type distribution transformers.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work to furnish and install transformers in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
   1. Electrical Component Standard: Components and installation shall comply with National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."
   2. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Compliance. Comply with applicable requirements of ANSI/IEEE Standards including C2, "National Electrical Safety Code," and C57.12.80, "Terminology for Power and Distribution Transformers."
   3. Nationally Recognized Testing Laboratory Compliance (NRTL). Items provided under this section shall be NRTL listed and labeled. The term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.

B. Qualifications
   1. Manufacturer Qualifications. Member firm of National Electrical Manufacturers Association (NEMA) who is regularly engaged in manufacturing components that comply with the requirements of these specifications and that have been used on at least five projects of similar size and scope as this project.
   2. Testing: Manufacturer's standard shop test shall be performed in accordance with the latest version of ANSI and NEMA standards and shall include as a minimum the following. Provide certified factory test reports.
      a. Ratio tests at the rated voltage connection and at all tap connections.
      b. Polarity and phase relation tests on the rated voltage connection.
      c. Applied potential tests.
      d. Induced potential tests.

e. No-load and excitation current at rated voltage on the rated voltage connection.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Wiring diagrams from manufacturer differentiating between manufacturer installed and field installed wiring.

C. Product certificates, signed by manufacturer of transformers certifying that their products comply with the specified requirements.

PART 2 – PRODUCTS

2.1 TRANSFORMERS, GENERAL

A. Transformers: Factory assembled and tested, air cooled units of types specified, having characteristics and ratings as indicated. Units shall be designed for 60 Hertz (Hz) service.
1. Cores: Grain oriented, nonaging silicon steel.
2. Coils: Continuous copper windings without splices except for taps.
3. Internal Coil Connections: Brazed or pressure type.

B. General Purpose, Dry Type Transformers
1. Comply with NEMA Standard ST 20 "Dry Type Transformers for General Applications."
2. Windings: Two winding type. Three phase transformers shall use one coil per phase in primary and secondary.
3. Enclosures: Unless otherwise noted on the drawings enclosures shall be indoor, ventilated.
4. Insulation Class: 185 deg C or 220 deg C class for transformers 15 kilovolt amperes (kVa) or smaller; 220 deg C class for transformers larger than 15 kVa.
5. Insulation Temperature Rise: 115 deg C maximum rise above 40 deg C.
6. Taps: For transformers 3 kVa and larger, full capacity taps in high voltage winding as follows:
   a. 15 kVa through 500 kVa: Six 2.5% taps, two above and four below rated high voltage.
7. Accessories: The following accessory items are required where indicated:
   a. Surge arresters: NEMA Standard LA1, low-voltage type, factory installed and connected to high-voltage terminals.
   b. Surge arresters: NEMA Standard LA1, low-voltage type, factory installed and connected to low-voltage terminals.

c. Electrostatic Shielding: Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection.

d. Wall Mounting Brackets. Manufacturers standard brackets for transformers sized up to 75 kVa where wall mounting is indicated.

8. Transformer sound levels shall not exceed ANSI standards.

9. Transformers installed in an area which has sprinklers shall have a weathershield.

10. All primary and secondary connections to transformers shall be made with flexible liquid-tight conduit.

C. Control and Signal Transformers

1. Comply with NEMA Standard ST 1 "Specialty Transformers," and UL Standard 506, "Specialty Transformers."

2. Ratings: As indicated and for continuous duty. Where ratings is not indicated, provide capacity in excess of load.

3. Type: Self-cooled, two winding dry type.

4. Enclosure: Indoor, except as indicated.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

1. Transformers

a. Cutler Hammer/Westinghouse.

b. Square D Co.

c. Siemens Energy & Automation, Inc.

d. General Electric Co.

e. Or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Arrange equipment with a minimum clearance of 6 inches from any wall, to provide adequate spacing for cooling air circulation.

B. Identify transformers in accordance with Division 26 Section “Electrical Identification”.

C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL Standards 486A and 486B.

D. Install units on vibration mounts as shown; comply with manufacturer's indicated installation method, if any. Indoor installations over 30 kVa shall be set on top of a

housekeeping pad. Indoor installations 30 kVa and under shall be wall mounted using steel angle frame.

3.2 GROUNDING

A. Ground transformers and tighten connections to comply with tightening torques specified in UL Standard 486A.

B. Transformer secondary neutral shall be grounded to building structural steel in conformance with the N.E.C.

3.3 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262416 – PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install panelboards and enclosures in accordance with the plans and as specified herein.

B. Types of panelboards and enclosures required for the project include the following:
1. Panelboards.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with panelboards in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and National Electrical Code (NEC) Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
2. Underwriters' Laboratories, Inc. (UL) Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards," and UL Numbers 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and -labeled.
3. Special Use Markings: Provide panelboards, constructed for special use, with appropriate UL markings which indicate that they are suitable for special type of use/application.
4. National Electrical Manufacturers Association (NEMA) Compliance: Comply with NEMA Standards Pub/No. 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

1.3 SUBMITTALS

A. Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit manufacturer's data on panelboards, components, and enclosures.

C. Submit shop drawings from manufacturers of panelboards including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
   1. Enclosure type with details for types other than NEMA Type 1.
   2. Bus configuration and current ratings.
   3. Short circuit current rating of panelboard.
   4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Reference Submittals
   1. Test reports.
   2. Manufacturer's descriptive literature.
   3. Operating and maintenance instructions.
   4. Spare parts list.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver panelboards and components properly packaged in factory-fabricated-type containers.

B. Handle panelboards and components carefully to avoid breakages, impacts, denting, and scoring finished. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

C. Store panelboards and components in original packaging and in a clean, dry space; protect from weather and construction traffic.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, provide panelboards which are fully rated, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.

B. Panelboards: All lighting and receptacle panels shall be of the same manufacturer.
   1. Provide dead front safety type, fully rated (series rating is not acceptable), panelboards rated 480y/277 volt, 3-phase, 4-wire; or 208Y/120 volt, 3-phase, 4-wire; or 120/240 volt, single-phase, 3-wire; as indicated on the Contract Drawings, with switching and protective devices in quantities, ratings, types and arrangements shown; with antiburn solderless pressure type lug connectors approved for use with copper conductors.
   2. Construct unit for connecting feeders at top or bottom of panel as indicated.
   3. Equip with copper bus bars, full-sized copper neutral bar.
   4. Equip with bolt in type heavy-duty, quick-make, quick-break, thermal magnetic circuit breakers with toggle handles that indicate when tripped. Each breaker shall have a symmetrical interrupting capacity of 22,000 AIC RMS for 480/277 volt, 3-phase, 4-wire, panelboards; 10,000 AIC RMS for 208/120 volt, 3-phase, 4-wire and 120/240 volt, single-phase, 3-wire unless noted otherwise on the panel schedules.
   5. Provide suitable lugs on neutral bus for each outgoing feeder required.
   6. Provide bare uninsulated copper grounding bars suitable for bolting to enclosures.

C. Provide NEMA 12,3R galvanized sheet steel or NEMA 4X stainless steel cabinet type enclosures as indicated on the Contract Drawings.
   1. Construct with multiple knockouts and wiring gutters.
   2. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Provide 2 keys with each lock.
   3. Equip with interior circuit directory frame, and card with clear plastic covering.
   4. Provide baked gray enamel finish over a rust inhibitor coating (NEMA 12 and 3R only).

D. Provide panelboard accessories and devices including, but not necessarily limited to, ground fault protection units, locking clips, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

E. Circuit Breakers
   1. Provide circuit breakers as specified in Division 26 Section “Overcurrent Protective Devices”. Panelboards shall have main circuit breaker or main lugs, and branch circuit breakers as shown on the schedules.
   2. Provide circuit breaker handle locks for all circuit breakers that supply exit and emergency lighting, fire alarm equipment, and where indicated on plan or schedule.

F. Provide equipment identification nameplates complying with Division 26 Section “Electrical Identification”.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):
1. Cutler Hammer/Westinghouse.
2. Square D Company.
3. Siemens Energy Automation, Inc.
4. General Electric Company.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and National Electrical Contractors Association's (NECA) "Standards of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

C. Fasten surface-mounted enclosures firmly to walls with 1/4-inch space between wall and panelboard, ensuring that they are permanently and mechanically anchored.

D. Provide properly wired electrical connections for panelboards within enclosures.

E. Fill out in typed form each panelboard's circuit directory card upon completion of installation work.

3.2 EXAMINATION

A. Examine areas and conditions under which panelboards and enclosures are to be installed and notify the Engineer in writing of conditions detrimental to proper completion of work.

3.3 GROUNDING

A. Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to ensure permanent and effective grounds. All panelboards shall be properly grounded. Special requirements shall be as indicated on plans.

3.4 FIELD QUALITY CONTROL

A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits, and for short circuits.

D. Measure steady state load currents at each panelboard feeder and rearrange circuits in the panelboard to balance the phase loads within 10% of each other. Maintain proper phasing for multi-wire branch circuits.

3.5 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262419 – MOTOR CONTROL CENTERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install MCCs in accordance with the plans and as specified herein.
   1. This section includes MCCs for use on alternating current (AC) circuits rated 600 volts (V) or less. Extent of MCC work is indicated by drawings and schedules.
   2. Types of MCC components specified in this section include the following:
      a. MCC supporting structures.
      b. Bus systems.
      c. Unit compartments.
      d. Motor controller units.
      e. Feeder units.
      f. Overload protection.
      g. Overcurrent protection.
      h. Control components.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work to furnish and install in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
   1. Provide MCCs that are listed and labeled.
      a. The terms "listed and "labeled": As defined in the National Electrical Code (NEC), Article 100.
      b. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
   2. Electrical Component Standard: National Fire Protection Association (NFPA) 70, "NEC," for components and installation.
   3. National Electrical Manufacturers Association (NEMA) Standard: NEMA ICS 2, "Standards for Industrial Control Devices, Controllers and Assemblies."
   4. Underwriters' Laboratories, Inc. (UL) Standard: UL 845, "Motor Control Centers. "

B. Manufacturer's Field Representative

1. The Manufacturer of the Work of this Section shall provide a qualified field representative at the site.
2. Such Manufacturer's field representative shall instruct the Contractor's personnel in the proper handling, installation, start-up, operation, and maintenance of the equipment.
3. Such Manufacturer's field representative shall instruct the Owner's personnel in the proper start-up, operation, and maintenance of the equipment.

C. Testing: Manufacturer's standard factory tests shall be performed.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and material specifications as required.

B. Reference Submittals
1. Installer's certification.
2. Manufacturer's certification.
3. Manufacturer's descriptive literature.
4. Certified production test reports.
5. Operating and maintenance instructions.

C. Submit the following:
1. Product Data: Submit manufacturer's technical product data on MCC. Application data to include, but not limited to, the following:
   a. Voltage.
   b. Phase.
   c. Frequency.
   d. Horizontal bus capacity.
   e. Vertical bus capacity.
   f. Short circuit ratings.
   g. Main and branch circuit breakers ratings.
   h. Types of motor controllers.
   i. Types of wiring (NEMA type wiring).
   j. Enclosures.
   k. Sections.
   l. Motor size and overload heaters.
2. Shop Drawings: Submit layout drawings of MCCs showing accurate scaled basic equipment sections including, but not limited to, motor controllers, device panels, and circuit breakers. Show spatial relationships of MCC components to proximate electrical equipment. Submit unit wiring diagrams and elementary control diagrams. Clearly differentiate on wiring diagrams those conductors which are factory installed and those which are field installed.

a. Front view elevation.
b. Floor plan.
c. Single line.
d. Unit wiring diagrams depicting remote devices.
e. Nameplate schedule.
f. Starter and component schedule.
g. Conduit entry/exit locations.

3. Maintenance Data: Submit maintenance data and parts list for each MCC; including "troubleshooting" maintenance guide. Include that data, product data, and shop drawings in a maintenance manual.
4. Overload Relay Heater List: Submit for approval overload relay heater sizes for each new motor starter furnished or existing motor starter modified. Motor overload relay heater size shall be based on actual motor nameplate data (shop drawing is not acceptable) and power factor correction size; where applicable. Submit for approval motor overload relay heater sizing criteria, manufacturer, support calculations, motor nameplate data, capacitor nameplate data, and manufacturer tables used.
5. Submit agenda of training class.

D. A Renewal Parts List shall be submitted by the Manufacturer and Contractor showing the important maintenance items which will need to be available for proper maintenance and to provide normal equipment life.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle MCCs in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory installed lifting provisions.

C. Store so condensation will not occur on or in MCCs. Provide temporary heaters as required to prevent condensation. If the motor control center cannot be placed into service reasonably soon after its receipt, it should be stored in a clean, dry and ventilated building free from temperature extremes. Acceptable storage temperatures are from 0□C (32□F) to 40□C (104□F).

1.5 WARRANTY

A. Manufacturer Warranty
1. Period: 1 year.

2. The Manufacturer shall warrant to repair or replace, without cost or undue hardship to the Owner, all of the Manufacturer's Work that is found to be defective, that is not in accordance with the Contract Documents, that fails to performs as represented by the Manufacturer's published product information, or that does not meet generally recognized standards of quality or performance for such Work, whichever is greater. Such warranty shall include the removal and replacement, without cost or undue hardship to the Owner, of all other Work which is damaged as a result of removal or replacement of the Manufacturer's Work which is defective or nonconforming or nonperforming, as set forth above.

B. Installer Guarantee and Warranty
1. Period: 1 year.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Motor Control Centers
1. General
a. Provide MCCs and ancillary components of sizes, rating classes, types, and characteristics, indicated; which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for complete installation and as specified herein. See the plans for required components.
b. Conduit entrance shall be via a grounding, threaded fitting.
2. Provide MCCs consisting of one or more vertical sections, each with groupings of unit compartments containing motor controllers, feeder, and auxiliary devices as indicated.
3. Design MCC for connection to available faults of not less than 42,000 RMS symmetrical amperes or as shown on plans. Provide MCC with NEMA Class 2, Type B wiring. All wiring shall be identified by permanent plastic heat shrink label at each termination.
4. Provide factory assembled, deadfront, MCC standard supporting structures of Classes and Types indicated; with enclosed vertical sections, as indicated, fastened together to form rigid free-standing assembly.
a. Construct each section 90 inches high with minimum 6 inch horizontal wireways at top and bottom, 20 inches wide, and a minimum of 20 inch section depth except back to back structures shall be 25 inches in depth.
b. Top horizontal wireway shall be isolated from horizontal bus.
c. Provide NEMA Type 12 enclosure.

d. Construct units with vertical wireway in each vertical structure on right side of unit, accessible through hinged doors, and with supports at proper intervals within for fastening wires/cables. Form supporting members of not less than 13 gauge hot rolled steel.

e. Construct structure doors with removable pin hinges and secure with quarter turn indicating type fasteners.

f. Provide removable lifting angle full length of MCC. Design lifting angle to support entire weight of MCC section. Design bottom channels to be removable, provide holes for bolting MCC units to floor.

g. Provide shipping splits in MCC lineup to allow for shipment of maximum 60-inch-long units. Design MCCs so matching vertical sections of same current rating and manufacturer can be added later at either end of lineup without use of transition sections. Provide removable end and top plates to close off openings.

5. Construct bus bars of tin-plated copper, braced to withstand faults of 42,000 RMS symmetrical amperes minimum or as indicated on plans. Provide main horizontal bus with rating of 600 amperes, and vertical bus rating of 300 amperes unless otherwise noted. Construct vertical bus bar barriers with automatic shutters to cover bus stab openings when units are removed.

   a. Provide tin plated copper ground bus running full width of MCC at bottom of lineup. Drill ground bus and furnish lugs as indicated.

6. Provide draw out type unit compartments with doors, unit support pans, saddles, and disconnect operators. Enclose and isolate each unit from adjacent units. Design units so that faults will be contained within compartments and with a minimum withstandability equal to that of the bus bracing. Provide draw out units with a de-energized position where the unit is still supported by the structure, but no electrical connection is made. Provide a method of locking the unit in the de-energized position. Design plug in units of the same type and size to be interchangeable with each other. Provide plug on connections for each electrical power phase. Design the contact fingers to be floating and self-aligning. Tin plate the contacts for low resistance connections. Interiors shall be painted white or off white. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 volts. Knockouts shall be provided for the addition of future terminal blocks. All control wire to be 14 gauge minimum.

7. Provide external operator handles for controllers, switches, and circuit breakers. Design handle with up-down motion and with down position indicating OFF. Construct handles which permit locking handle in OFF position with three padlocks.

8. Provide unit doors securely mounted with a minimum of two rugged concealed type hinges which allows doors to swing open minimum of 115 degrees for ease of unit maintenance and withdrawal. Fasten doors to structure so that they remain in place when unit is withdrawn.

a. Closed door must cover unit space when unit has been temporarily removed. Provide interlock for each unit door with associated disconnect mechanism to prevent door from opening when unit is energized.

9. Circuit Breakers: See Division 26 Section "Overcurrent Protective Devices". Devices shall have a minimum RMS symmetrical interrupting rating of 42,000 A at 480/277V.
10. Main Circuit Breakers: Provide solid state trip circuit breakers. See plans and/or schedules for size. See Division 26 Section "Overcurrent Protective Devices". Devices shall have a minimum RMS symmetrical interrupting rating of 42,000 A at 480/277V.
11. Provide combination type motor controller units, types as specified in Division 26 Section "Motor Controllers", with thermal magnetic circuit breaker or fused switch and ambient compensated, manual reset, inverse time, thermal overload relay. Overload protection shall be provided in each phase conductor. Provide overload heaters sized based upon motor nameplate current. Provide a 120 volt control power transformer for each motor controller unit with two primary fuses and one secondary fuse. The transformer secondary shall be grounded. Provide a minimum of three normally open and one normally closed auxiliary contacts. Units shall be NEMA rated.
12. All control component conductors shall be landed with vinyl insulated locking fork terminals. Elapsed time meters shall be mounted in the unit doors and shall have a 120-volt synchronous motor driving a mechanical register. The register shall indicate up to 99,999.9 hours. Each motor starter NEMA Size 2 or larger shall have a current sensing phase unbalance relay to trip the starter on loss of phase or phase unbalance of 50 percent or more when at 50 percent or more load.
13. Provide equipment/system identification nameplates complying with Division 26 Section "Electrical Identification", in accordance with Motor Control Schedule on drawings. Tags shall be engraved plastic laminate.
14. Thoroughly clean interior and exterior of supporting structures and unit compartments prior to coating of MCC, including bolted joints, with rust-inhibiting prime coat. Provide two finish coats of manufacturer's standard color baked on enamel finish.

B. Extra Materials
1. Furnish six spares of each type and rating of fuse and fusible devices required. Include spares for:
a. Control power fuses.
2. Spare Indicating Lights: Furnish six of each type required.
3. Touch-Up Paint: Furnish three 1/2-pint containers.

2.2 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Cutler-Hammer.
2. Square D.
3. Allan Bradley.
4. Siemens.
5. General Electric.
6. Or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Examine areas and conditions under which motor control centers are to be installed, and substrate which will support motor control centers. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to A/E.

B. Installation of Motor Control Centers
1. Install MCCs as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of NEC, NEMA's Standard Pub/No. ICS-2, and NEC "Standard of Installation."
2. Provide and install housekeeping pads for all motor control centers.
3. Coordinate with other electrical work including wiring/cabling and raceway work, as necessary to interface installation of motor control centers with other work. Install control wiring from master terminal block in top and bottom horizontal wireways to each associated unit compartment terminal blocks.
4. Install fuses, if any, in motor control center units.
5. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.
6. Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

C. Adjusting and Cleaning
1. Adjust operating mechanisms for free mechanical movement.
2. Touch up scratched or marred surfaces to match original finishes.

D. Grounding: Provide equipment grounding connections for MCCs as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of MCCs, check with insulation resistance tester for proper values of phase-to-phase and phase-to-ground insulation resistances. Log that data, and submit to Engineer.

B. Prior to energization of circuitry, check control center electrical circuits for continuity and for short circuits.

C. Subsequent to wire/cable and raceway hook ups, energize MCC circuitry check each motor for proper phase rotation, and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

D. Install approved overloads after all wiring is checked.

E. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
   1. Perform insulation tests on each phase and verify low resistance ground connection on ground bus.
   2. Torque all bolted connections made in the field and verify all factory bolted connections.
   3. Verify proper application of motor overloads and motor circuit protectors against actual nameplate data.
   4. The Contractor shall provide three (3) copies of the manufacturer's field startup report before final payment is made.

3.3 FIELD ADJUSTMENTS

A. Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or startup of components.

3.4 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification before final payment is made.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262716 – CABINETS, BOXES AND FITTINGS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install electrical boxes and fittings in accordance with the plans and as specified herein.

B. Types of electrical boxes and fittings specified in this section include the following:
1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Floor boxes.
5. Bushings.
6. Locknuts.
7. Knockout closures.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. National Electrical Code (NEC) Compliance. Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
2. Underwriters' Laboratories (UL) Compliance. Comply with applicable requirements of UL 50, UL 514 Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes, fittings and enclosures which are UL listed and labeled.
3. National Electrical Manufacturer's Association (NEMA) Compliance. Comply with applicable requirements of NEMA Standard Publication Nos. OS1, OS2, and 250 pertaining to outlet and device boxes, covers, and box supports.
4. Federal Specification (FS) Compliance. Comply with applicable requirements of FS W-C-586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies and Entrance Caps."

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Shop Drawings for Electrical Boxes and Fittings: For shop-fabricated junction and pullboxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Store cabinets, boxes and fittings in clean, dry space; protect products from weather, damaging fumes, construction debris and traffic.

PART 2 – PRODUCTS

2.1 ELECTRICAL BOXES AND FITTINGS

A. Electrical cabinets, boxes and fittings of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations. Provide corrosion-resistant box knockout closures to suit respective installation requirements and applications.

2.2 METALLIC OUTLET, DEVICE AND WIRING BOXES

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical" and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes, and accessories suitable for each location, including mounting brackets and straps, cable clamps, exterior rings, and fixture studs.

C. Cast Aluminum Boxes: Copper-free aluminum threaded raceway entries and features and accessories suitable for each location including mounting ears, threaded screw holes for devices, and closure plugs.

2.3 NON-METALLIC OUTLET, DEVICE, AND WIRING BOXES

A. General: Conform to NEMA OS 2, "Non-Metallic Outlet Boxes, Device Boxes, Covers, and Box Supports," and UL 514C, "Non-Metallic Outlet Boxes, Flush Device Boxes, and Covers." Boxes shall be molded PVC units of type, shape, size, and depth to suit location and application.

B. Non-Metallic Boxes: Ultraviolet stabilized, non-conductive, high-impact-resistant boxes with integrally molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have molded cover of matching polyvinyl chloride (PVC) material suitable for the application.

2.4 PULL AND JUNCTION BOXES

A. General: Comply with UL 50, "Electrical Cabinets and Boxes," for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted-on covers of same material as box and shall be of size and shape to suit application. All boxes 6-inch x 6-inch or larger shall have hinged doors.

B. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanize after fabrication. Cover shall be gasketed.

C. Stainless Steel Boxes: Fabricate of stainless-steel conforming to Type 302 of American Society for Testing and Materials (ASTM) A 167, "Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip." Where necessary to provide a rigid assembly, construct with internal structural stainless-steel bracing. Cover shall be gasketed.

D. Cast Aluminum Boxes: Molded of copper-free aluminum, with gasketed cover and integral threaded conduit entrances.

E. Cast Nonmetallic Boxes: Ultraviolet stabilized, non-conductive, high-impact-resistant PVC boxes with gasketed cover and integral mounting flanges.

2.5 STEEL ENCLOSURES WITH HINGED DOORS

A. General: Comply with UL 50, "Cabinets and Enclosures," and NEMA ICS6 "Enclosures for Industrial Control and Systems."

B. Construction: Sheet steel, 16-gauge, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface-mounting.

C. Doors: Hinged directly to cabinet and removable with approximately 3/4-inch flange around all edges, shaped to cover edge of box. Provide handle-operated, key-locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.

D. Mounting Panel: Provide painted removable internal mounting panel for component installation.

E. Enclosure: NEMA 12 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips.

2.6 CAST METALLIC ENCLOSURES WITH HINGED DOORS

A. General: Copper-free aluminum with bolted, hinged doors. Where used at hazardous (classified) locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

2.7 MOLDED NONMETALLIC ENCLOSURES WITH HINGED DOOR

A. General: Molded, glass-fiber-reinforced high-impact-strength polyester with bolt or screw-secured doors and solid neoprene gaskets.

2.8 CORROSION INHIBITORS

A. General: All enclosures containing equipment, terminals, or splices shall have a vapor phase corrosion inhibitor. Provide two spares for each one installed.

2.9 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Adalet-PLM Div.; Scott Fetzer Co.
2. American Electric.
3. Arrow-Hart Div.; Crouse-Hinds, Co.
4. Appleton Electric Co.; Emerson Electric Co.
5. Harvey Hubbell, Inc.
6. OZ/Gedney Co.; General Signal Co.
7. Pass and Seymour, Inc.
8. Thomas & Betts Co., Inc.
9. Walker; Wire Mold Company.
10. Or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractor's Association (NECA) "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Install items where indicated and where required to suit code requirements and installation conditions. Cap unused knockout hole where blanks have been removed and plug unused conduit hubs so as to maintain the NEMA rating of the box. Install boxes in locations which ensure ready accessibility to enclosed electrical wiring and avoid installing boxes back-to-back in walls where there would be less than 6 inches (150 mm) separation. Fasten boxes firmly and rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Do not install aluminum products in concrete.

C. Outlet and device boxes for flush-mounted installation shall be a minimum of 4-inch square or octagonal and positioned accurately to allow for surface finish thickness.

D. Junction boxes, pullboxes, and enclosures with hinged doors which are surface-mounted shall utilize spacers to maintain 1/4-inch clearance from the wall.

E. Floor boxes shall be installed level and flush with finish flooring material.

F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and secure connections when fastened with locknut or bushing on rounded surfaces.

G. Provide electrical connections for installed boxes.

3.2 COORDINATION

A. Coordinate installation of electrical cabinets, boxes, and fittings with wire/cable, wiring devices, and raceway installation work.

3.3 APPLICATIONS

A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the Contract Drawings and the following requirements:
   1. Use galvanized flat rolled sheet steel boxes where shown concealed in finished areas with framed construction.
   2. Each box with associated covers and fittings shall have a NEMA rating suitable for each location installed.

B. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location and in conformance with the following:
   1. Each box with associated covers and fittings shall have a NEMA rating suitable for each location installed.

C. Enclosures with Hinged Doors: Install enclosures and associated materials and NEMA types suitable for each location and in conformance with the drawings.

D. Floor Boxes: Install cast iron floor boxes at each location indicated.

3.4 GROUNDING

A. General: Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

3.5 CLEANING AND FINISH REPAIR

A. General: Upon completion of installation, inspect components, remove burrs, dirt, and construction debris, and repair damaged finish including chips, scratches, abrasions, and weld marks.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262726 – WIRING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install wiring devices in accordance with the Plans and as specified herein.
   1. This section includes the following:
      a. Receptacles.
      b. Ground fault circuit interrupter receptacles.
      c. Snap switches.
      d. Incandescent lamp dimmer switches.
      e. Wall plates.
      f. Surface-mounted service fittings.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work to furnish and install wiring devices in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
   1. Regulatory Requirements. Comply with provisions of the following codes.
   2. National Fire Protection Association (NFPA) 70 "National Electrical Code (NEC)."
   3. Underwriters' Laboratories, Inc. (UL) and National Electrical Manufacturers Association (NEMA) Compliance. Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.3 SUBMITTALS

A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following:
   1. Product data for each type of product specified.

1.4 JOB CONDITIONS

A. Sequence and Scheduling: Schedule installation of finish plates after the surface upon which they are installed has received final finish.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Deliver wiring devices and components properly packaged in factory-fabricated-type containers.

B. Handle wiring devices and components carefully to avoid breakages, impacts, denting, and scouring finishes. Do not install damaged equipment; replace/return damaged units to equipment manufacturer.

C. Store wiring devices and components in original packaging and in a clean, dry space; protect from weather and construction traffic.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Wiring Devices
a. Bryant Electric Co.
b. Hubbell, Inc.
c. Leviton.
2. Dimmers
a. Carlon-Thyrocon.
b. Lutron.

B. Wiring Devices
1. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL-listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Devices on normal power shall be a color as selected by the owner.
2. Receptacles
a. As scheduled in Table 1 in Part 3 below. Comply with UL 498, NEMA WD 1 and verified under Fed. Spec. #WC596.
b. Receptacles, Industrial Heavy Duty. Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.
c. Ground Fault Interrupter (GFI) Receptacles. As indicated in Table 1 in Part 3 below; provide "feed-through"-type ground fault circuit interrupter, with integral heavy duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4-inch-deep outlet box

without adapter, grounding-type, Class A, Group 1, per UL Standard 943.

3. Switches
   a. Snap Switches: Quiet-type alternating current (ac) switches as indicated in Table 2 in Part 3 below. Comply with UL 20, NEMA WD1 and verified under Fed Spec. #W-S896-E.

4. Dimmer Switches: Solid-state dimmer switches conforming to NEMA WD 1, mounted in outlet boxes as indicated and in accordance with the following:
   a. Incandescent Lamp Dimmers: Modular dimmer switches for incandescent fixtures; switch poles as indicated, 2000 watt, 120 volts, 60 hertz (Hz), with continuously adjustable linear slide, anodized aluminum face. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch wire connecting leads.

C. Wiring Device Accessories
1. Wall Plates: Single and combination, of types, sizes, and with ganging and cut-outs as indicated. Provide plates which mate and match finish with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plates with engraved legend where indicated. Conform to requirements of Division 26 Section “Electrical Identification”.
2. Weatherproof Covers: Weatherproof covers shall be rain-proof while in use and shall be in full compliance with NEC Article 410-57. There shall be a neoprene gasket between the enclosure and the mounting surface and between the cover and base to ensure a proper seal.
3. Surface-Mounted Service Fitting: Modular surface-mounted service fittings of types and ratings indicated. Construct of die-cast aluminum, satin finish. Use design compatible with wiring methods indicated. Provide receptacles as indicated. Provide with 3/4-inch or 1-inch NPT, 1 inch long, locking nipple for installation where compatible with wiring method.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation of Wiring Devices and Accessories
1. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

2. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.
3. Mount all wall switches at 3'-6" above finished floor and all receptacles at 1'-6" above the finished floor, unless otherwise noted.
4. Install wiring devices only in electrical boxes which are clean and free from building materials, dirt, and debris.
5. Install wiring devices after wiring work is completed.
6. Install wall plates after painting work is completed.
7. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

3.2 PROTECTION

A. General: Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
   1. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

3.4 TABLES

A. Outlets

Type	Amperes	Volts	Config.	Hubbell Catalog Number	Leviton Catalog Number	Bryant Catalog Number
Duplex outlets	20	125	NEMA 5-20R	5362	5362	5362
Duplex outlet plates, flush or surface-mounted			Standard	S8	84003-40	S601
GFCI Outlet	20	125	NEMA 5-20R	GF5362W	-	GFR53FT-W
GFCI Outlet Plate				S26	-	S601D

B. Switches

Type	Amperes	Volts	Hubbell Catalog Number	Leviton Catalog Number	Bryant Catalog Number
Single-pole switch	20	120-277	1221	1221	4901
Double-pole switch	20	120-277	1222	1222	4902
Three-way switch	20	120-277	1223	1223	4903
Four-way switch	20	120-277	1224	1224	4904
Switch plates, flush or surface-mounted			S1	84001-40	S671

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 262800 – CIRCUIT AND MOTOR DISCONNECTS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. General: The Contractor shall provide the labor, tools, equipment, and material necessary to install circuit and motor disconnects in accordance with the Plans and as specified herein.

B. Extent of circuit and motor disconnect switch work is indicated by drawings and schedules.

C. Types of circuit and motor disconnect switches in this section include the following:
1. Equipment disconnects.
2. Motor circuit disconnect.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Perform all work associated with circuit and motor disconnects in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. National Electrical Code (NEC) Compliance. Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.
2. Underwriters' Laboratories, Inc. (UL) Compliance. Comply with requirements of UL 98 "Enclosed and Dead Front Switches." Provide circuit and motor disconnect switches which have been UL listed and labeled.
3. National Electrical Manufacturers Association (NEMA) Compliance. Comply with applicable requirements of NEMA Standards Pub No. KS 1 "Enclosed Switches" and 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

1.3 SUBMITTALS

A. General: Furnish samples, manufacturer's product data, test reports, and materials certifications as required.

B. Submit the following:
1. Product data for each type of product specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver circuit and motor disconnect switches properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.

B. Store circuit and motor disconnect switches in original packaging and protect from weather and construction traffic. Wherever possible, store indoors, where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle circuit and motor disconnect switches carefully to prevent physical damage. Do not install damaged disconnect switches, remove from site and replace damaged devices with new.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Heavy Duty Safety Switches: Provide surface mounted, heavy-duty type, enclosed safety switches, of types, sizes, and electrical characteristics as required for the indicated installation; fused if noted on plan. Provide switches incorporating quick make, quick break type switches, so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable and is padlockable in OFF position. Construct current carrying parts of high conductivity copper with silver tungsten type switch contacts; and positive pressure type reinforced fuse clips where fusible switches are specified or required by code.

B. Fuses: Provide fuses for safety switches, as noted on plans and as described in Division 26 Section “Overcurrent Protection Devices”.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects of one of the following (for each type of switch):
   1. Cutler-Hammer/Westinghouse.
   2. Square D Company.
   3. Siemens.
   4. General Electric.
   5. Or equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and National Electrical Contractor's Association (NECA) "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches for use with motor driven equipment, motors and controllers within sight of the motor position unless otherwise indicated.

D. Provide suitable means for mounting disconnect switches.

3.2 GROUNDING

A. Provide equipment grounding connections, tightened to assure a permanent and effective ground, for electrical disconnect switches where indicated.

3.3 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS (DRIVES)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PCC: Point of common coupling.

M. PID: Control action, proportional plus integral plus derivative.

N. PWM: Pulse-width modulated.

O. RFI: Radio-frequency interference.

P. TDD: Total demand (harmonic current) distortion.

Q. THD(V): Total harmonic voltage demand.

R. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
   1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Enclosure types and details.
      d. Nameplate legends.
      e. Short-circuit current (withstand) rating of enclosed unit.
      f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
   2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Certificates: For each VFC, from manufacturer.

C. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

D. Source quality-control reports.

E. Field quality-control reports.

F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017839 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
   2. Manufacturer's written instructions for setting field-adjustable overload relays.
   3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Indicating Lights: Two of each type and color installed.
   4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
   5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store in space that is permanently enclosed and air conditioned.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than 5 deg F and not exceeding 122 deg F.
   2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
   3. Humidity: Less than 95 percent (noncondensing).
   4. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of electrical systems.
   2. Indicate method of providing temporary electrical service.
   3. Do not proceed with interruption of electrical systems without Owner's written permission.
   4. Comply with NFPA 70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.11 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
   1. Torque, speed, and horsepower requirements of the load.
   2. Ratings and characteristics of supply circuit and required control sequence.
   3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturer:
   1. Schneider Electric Altivar family 900 series process drives

B. Show VFC pole quantities, voltage, accessories, size and type, short-circuit current (withstand) rating (or available short-circuit currents), and enclosure type for each controller on Drawings. See "Specifying VFCs" Article and Editing Instruction No. 9 in the Evaluations for selection considerations.

C. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 0.1 to 60 Hz, with torque constant as speed changes; maximum voltage equals input voltage.

G. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus, or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 50 kA.
7. Ambient Temperature Rating: Not less than 5 deg F and not exceeding 122 deg F.
8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
9. Humidity Rating: Less than 95 percent (noncondensing).
10. Altitude Rating: Not exceeding 3300 feet.
11. Overload Capability: 1.2 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus, or minus 10 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 8 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
   1. Signal: Electrical.

J. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 0.1 to 999.9 seconds.
   4. Deceleration: 0.1 to 999.9 seconds.
   5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
   2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   3. Under- and overvoltage trips.
   4. Inverter overcurrent trips.
   5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
   6. Critical frequency rejection, with selectable, adjustable deadbands.
   7. Instantaneous line-to-line and line-to-ground overcurrent trips.
   8. Loss-of-phase protection.
   9. Reverse-phase protection.
   10. Short-circuit protection.
   11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

P. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

Q. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
2. Run.
3. Fault.

B. Selector Switches: Door-mounted selector switch for the following conditions:
1. Remote/Local Operation
2. Hand/Off/Auto Operation

C. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

D. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

E. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

F. Control Signal Interfaces:
1. Electric Input Signal Interface:
    a. A minimum of two programmable analog inputs: 4 to 20-mA dc

b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

   a. 4- to 20-mA dc.
   b. Potentiometer using up/down digital inputs.
   c. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of two programmable analog output signal(s) 4- to 20-mA dc, which can be configured for any of the following:
   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of three programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.
   e. Remote/Local Operation

G. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
   1. Number of Loops: Two

H. SCADA Interface: Factory-installed hardware and software to enable the SCADA to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
   1. Network Communications Ports: Ethernet.
   2. Communications options: Ethernet TCP/IP
   3. Embedded BAS Protocols for Network Communications: Modbus protocols accessible via the communications ports.

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Provide input filtering, as required, to limit TDD at input terminals of all VFCs to less than 5 percent and THD(V) to 3 percent.

B. Output Filtering: Provide dv/dt filters, as required, where circuit length between VFC and motor exceed 100 feet.

2.4 OPTIONAL FEATURES

A. Damper control circuit with end of travel feedback capability.

B. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

C. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

D. Communication Port: RJ-45 port.

2.5 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.6 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
   1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, type.
      a. Push Buttons: Recessed.
      b. Pilot Lights: LED types.
      c. Selector Switches: Rotary type.

B. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
   1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

C. Cooling Fan and Exhaust System: For NEMA 250, Type 12; UL 508 component recognized: Supply fan, with stainless steel intake and exhaust grills and filters; 120-V ac obtained from integral CPT

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2
   1. Test each VFC while connected to its specified motor.
   2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification.

3.3 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

C. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFC with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and facility's central-control systems. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
   2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:
1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:
1. Inspect VFC, wiring, components, connections, and equipment installation.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
   b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges.

F. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:
1. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Product Certificates: For each type of fixture, from manufacturer.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project, use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
   2. Warranty Period for Self-Powered Exit Sign Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.4 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports, and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, and reinstall.

C. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 266010 – HEAT TRACE

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the requirements for materials and support services for electric heat-tracing systems supplied by the vendor. Neither the supply of the materials related to the connection of the power supply, nor the installation of the entire system is part of this specification.

1.2 CODES, APPROVALS, AND STANDARDS

A. The electric heat-tracing system shall conform to the specification. It shall be designed, manufactured, and tested in accordance with the applicable requirements of the latest edition of the following codes and standards.

FM	FM Approvals LLC
IEEE 515	Institute of Electrical and Electronics Engineers
NEC	U.S. National Electric Code (NFPA 70)
NECA 202-2013	Installing and Maintaining Industrial heat Trace Systems
NEMA	National Electrical Manufacturers Association
UL 746B	Underwriters' Laboratories, Inc.
ANSI	American National Standards Institute
CSA	Canadian Standards Association

PART 2 – PRODUCTS

2.1 MATERIALS

A. Self-Regulating Heating Cables
   1. All heat-tracing systems for use at temperatures up to a continuous exposure (maintain) of 302°F (150°C) and intermittent exposure temperature of 420°F (215°C) shall use a self-regulating heating cable.
      a. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
      b. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously.
      c. All cables shall be capable of passing a 1.6 kV dielectric test for one minute after undergoing a 10 ft-lb. impact (IEEE 515-1997 test 4.1.8).
   2. Freeze Protection Systems With No Steam Exposure

a. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) without the use of thermostats of the following.

Heating Cable	T-rating	Maximum Temperature
3 W/ft	T6	185°F (85°C)
5 W/ft	T6	185°F (85°C)
8 W/ft	T5	212°F (100°C)
10 W/ft	T4A	248°F (120°C)

b. The heating cable shall have a tinned copper braid with a resistance less than 8 mΩ/ft as determined by metallic covering conductivity test (IEEE 515-1997 test 4.1.13). The braid may be protected from chemical attack and mechanical abuse by an optional polyolefin or fluoropolymer outer jacket.

c. In order to provide rapid heat-up, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:

Heating Cable	S.R. Index (W/°F)	S.R. Index (W/°C)
3 W/ft	-0.020	-0.036
5 W/ft	-0.045	-0.080
8 W/ft	-0.058	-0.104
10 W/ft	-0.071	-0.127

d. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 100°F (38°C) and confirmed by the type test and published data sheets.

e. In order to facilitate longer circuit lengths and smaller breaker sizing. The heating cable shall have the following maximum inrush current at 50°F (10°C).

Heating Cable	Maximum Inrush @ time = 1 sec	Maximum Inrush @ time = 10 sec	Maximum Inrush @ time = 300 sec
3 W/ft, 120V	58 mA/ft	54 mA/ft	41 mA/ft
5 W/ft, 120V	155 mA/ft	128 mA/ft	66 mA/ft
8 W/ft, 120V	210 mA/ft	180 mA/ft	83 mA/ft
10 W/ft, 120V	432 mA/ft	319 mA/ft	123 mA/ft
3 W/ft, 240V	38 mA/ft	36 mA/ft	20 mA/ft
5 W/ft,	92 mA/ft	80 mA/ft	33 mA/ft
8 W/ft, 240V	127 mA/ft	106 mA/ft	41 mA/ft
10 W/ft, 240V	281 mA/ft	205 mA/ft	62 mA/ft

f. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self-ignition, the cable shall produce less than 10 percent of rated power when energized and heated to 302°F (150°C) for 30 minutes. After this test, if the cable is allowed to cool to 50°F (10°C) and is reenergized, it must not have an increasing power output leading to thermal runaway.

g. In order to confirm 3.1B, the self-regulating heating cable shall maintain between 75 and 110 percent of its original power output after having been cycled 500 times between 50°F (10°C) and 150°F (65°C), allowing no more than 12 minutes of dwell time at each temperature.

h. The heating cable shall have the following third-party approvals:

UL Listed	Ordinary areas
CSA Certified	Ordinary areas
	Class I, Division 2 groups A, B, C, D
	Class II, Division 2 groups F, G
FM Approved	Ordinary areas
	Class I, Division 2 groups B, C, D
	Class II, Division 2 groups F, G
	Class III, Division 2

i. The heating cable shall be type SRL with continuous exposure (maintain) capability up to 150°F (65°C) and continuous exposure capability up to 185°F (85°C) with power off, as manufactured by Chromalox.

3. Process Temperature Maintenance with No Steam Exposure

a. The heating cable shall consist of two 14 AWG nickel plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable has a temperature identification number (T-rating), without the use of thermostats, of the following:

Heating Cable	T-rating	Maximum Temperature
3 W/ft	T3	392 °F (200 °C)
5 W/ft	T3	392 °F (200 °C)
8 W/ft	T3	392 °F (200 °C)
10 W/ft	T2D	419 °F (215 °C)
15 W/ft	T2D	419 °F (215 °C)
20 W/ft	T2D	419 °F (215 °C)

b. The heating cable shall have a tinned copper braid with a resistance less than 8 mΩ/ft as determined by metallic covering conductivity test (IEEE 515-1997 test 4.1.13). The braid may be protected from chemical attack and mechanical abuse by an optional fluoropolymer outer jacket.

c. In order to provide rapid heat-up, and to prevent overheating of fluids, the heating cable shall have the following minimum self-regulating indices:

Heating Cable	S.R. Index (W/°F)	S.R. Index (W/°C)
3 W/ft	-0.010	-0.018
5 W/ft	-0.016	-0.029
8 W/ft	-0.022	-0.039
10 W/ft	-0.028	-0.050
15 W/ft	-0.042	-0.075
20 W/ft	-0.058	-0.104

The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 200°F (93°C) and confirmed by the type test and published data sheets.

d. In order to facilitate longer circuit lengths and smaller breaker sizing. The heating cable shall have the following maximum inrush current at 50°F (10°C).

Heating Cable	Maximum Inrush @ time = 1 sec	Maximum Inrush @ time = 10 sec	Maximum Inrush @ time = 300 sec
3 W/ft, 120V	76 mA/ft	71 mA/ft	41 mA/ft
5 W/ft, 120V	94 mA/ft	89 mA/ft	66 mA/ft
8 W/ft, 120V	118 mA/ft	112 mA/ft	83 mA/ft
10 W/ft, 120V	266 mA/ft	231 mA/ft	124 mA/ft
15 W/ft, 120V	355 mA/ft	308 mA/ft	166 mA/ft
20 W/ft, 120V	430 mA/ft	365 mA/ft	208 mA/ft
3 W/ft, 240V	38 mA/ft	36 mA/ft	20 mA/ft
5 W/ft, 240V	47 mA/ft	45 mA/ft	33 mA/ft
8 W/ft, 240V	59 mA/ft	56 mA/ft	41 mA/ft
10 W/ft, 240V	133 mA/ft	115 mA/ft	62 mA/ft
15 W/ft, 240V	178 mA/ft	154 mA/ft	83 mA/ft
20 W/ft, 240V	215 mA/ft	183 mA/ft	104 mA/ft

e. In order to confirm 3.1B, the self-regulating heating cable shall retain at least 85 percent of its original power output after having been cycled between 70°F (21°C) and 375°F (190°C) for 3 weeks. Eight hours of dwell time at 70°F (21°C) and 16 hours of dwell time at 375°F (190°C) shall be conducted with a minimum test of 500 hours.

f. The heating cable shall have the following third-party approvals:

UL Listed	Ordinary areas
CSA Certified	Ordinary areas
	Class I, Division 2 groups A, B, C, D
	Class II, Division 2 groups F, G
FM Approved	Ordinary areas
	Class I, Division 2 groups B, C, D
	Class II, Division 2 groups F, G
	Class III, Division 2

g. The heating cable shall be type SRM/E with continuous exposure (maintain) capability up to 302°F (150°C) and continuous exposure capability up to 420°F (215°C) power off, as manufactured by Chromalox.

4. Freeze Protection and Process Temperature Maintenance with Steam Exposure

a. The heating cable shall consist of two 14 AWG nickel plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the

cable has a temperature identification number (T-rating), without the use of thermostats, of the following:

Heating Cable	T-rating	Maximum Temperature
3 W/ft	T3	392 °F (200 °C)
5 W/ft	T3	392 °F (200 °C)
8 W/ft	T3	392 °F (200 °C)
10 W/ft	T2D	419 °F (215 °C)
15 W/ft	T2D	419 °F (215 °C)
20 W/ft	T2D	419 °F (215 °C)

b. The heating cable shall have a tinned copper braid with a resistance less than 8 mΩ/ft as determined by metallic covering conductivity test (IEEE 515-1997 test 4.1.13). The braid may be protected from chemical attack and mechanical abuse by an optional fluoropolymer outer jacket.

c. In order to provide rapid heat-up, and to prevent overheating of fluids, the heating cable shall have the following minimum self-regulating indices:

Heating Cable	S.R. Index (W/°F)	S.R. Index (W/°C)
3 W/ft	-0.010	-0.018
5 W/ft	-0.016	-0.029
8 W/ft	-0.022	-0.039
10 W/ft	-0.028	-0.050
15 W/ft	-0.042	-0.075
20 W/ft	-0.058	-0.104

The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 200°F (93°C) and confirmed by the type test and published data sheets.

d. In order to facilitate longer circuit lengths and smaller breaker sizing. The heating cable shall have the following maximum inrush current at 50°F (10°C).

Heating Cable	Maximum Inrush @ time = 1 sec	Maximum Inrush @ time = 10 sec	Maximum Inrush @ time = 300 sec
3 W/ft, 120V	76 mA/ft	71 mA/ft	41 mA/ft
5 W/ft, 120V	94 mA/ft	89 mA/ft	66 mA/ft
8 W/ft, 120V	118 mA/ft	112 mA/ft	83 mA/ft
10 W/ft, 120V	266 mA/ft	231 mA/ft	124 mA/ft
15 W/ft, 120V	355 mA/ft	308 mA/ft	166 mA/ft
20 W/ft, 120V	430 mA/ft	365 mA/ft	208 mA/ft
3 W/ft, 240V	38 mA/ft	36 mA/ft	20 mA/ft
5 W/ft, 240V	47 mA/ft	45 mA/ft	33 mA/ft
8 W/ft, 240V	59 mA/ft	56 mA/ft	41 mA/ft
10 W/ft, 240V	133 mA/ft	115 mA/ft	62 mA/ft
15 W/ft, 240V	178 mA/ft	154 mA/ft	83 mA/ft
20 W/ft, 240V	215 mA/ft	183 mA/ft	104 mA/ft

e. In order to confirm 3.1B, the self-regulating heating cable shall retain at least 85 percent of its original power output after having been cycled between 70°F (21°C) and 375°F (190°C) for 3 weeks. Eight hours of dwell time at 70°F (21°C) and 16 hours of dwell time at 375°F (190°C) shall be conducted with a minimum test of 500 hours.

f. The heating cable shall have the following third-party approvals:

UL Listed	Ordinary areas
CSA Certified	Ordinary areas
	Class I, Division 2, groups A, B, C, D
	Class II, Division 2, groups F, G
FM Approved	Ordinary areas
	Class I, Division 2 groups B, C, D
	Class II, Division 2 groups F, G
	Class III, Division 2

g. The heating cable shall be type SRM/E with continuous exposure (maintain) capability up to 302°F (150°C) and continuous exposure capability up to 420°F (215°C) with power off, as manufactured by Chromalox.

5. Systems for Division 1 Hazardous (Classified) Locations

a. The following requirements shall apply in addition to the criteria specified in paragraph 1,2 and 3.

1) A ground fault protection device set at 30 mA, with a nominal 100 ms response time, shall be used to protect each circuit.

2) The temperature identification number (T-rating) of the cable used shall comply with FM requirements as applicable.
3) Connection methods used with the cables hall be compatible and approved as a part of the system manufactured and supplied by the heating cable vendor for use in Division 1 locations.
4) The heating cable shall be HSRM-CT for maintain temperatures up to 302ºF (150ºC) and continuous exposure capability up to 420ºF (215ºC) with power off, as manufactured by Chromalox.
5) The heating cable shall have the following third-party approvals:
   FM approved Class I, Division 1 groups B, C, D
   Class II, Division 1 groups E, F, G
   Class III, Division 1
6) For plastic pipe and vessel applications, the heating cable shall be HSRL-CT, for maintain temperatures p to 150ºF (65ºC) and continuous exposure capability up to 185ºF (85ºC) with power off, as manufactured by Chromalox.

2.2 TERMINATION FOR SELF-REGULATING HEATING CABLES

A. All connection components used to terminate self-regulating heating cables, including power connectors, splices, tees, and connectors, shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacture.

B. In order to keep connections dry, components shall be rated NEMA 4.

2.3 MINERAL INSULATED CABLE SYSTEMS

A. All heat-tracing applications with continuous exposure (maintain) temperatures above 302ºF (150ºC) or intermittent exposure temperatures above 420ºF (215ºC) shall use factory-terminated, mineral insulated (MI) cables.
   1. MI cable shall be magnesium oxide insulated with an Incoloy 825sheath. The heated section of the cable shall be joined to a cold lead also made of Incoloy 825.
   2. Each cable shall be factory-terminated to the required length, consisting of the lengths required for the pipe or equipment, plus an allowance for areas of additional heat loss such as valves, flanges, fittings, supports, etc. plus a reasonable excess to allow for field variations. The cold lead section shall be seven feet long unless otherwise specified.
   3. Maximum heating cable sheath temperatures, calculated according to the method outlined in IEEE Std 515-1997 section 6.4 shall be submitted with the bid or design for all Division 1 and Division 2 applications.
   4. Each cable shall be shipped with the catalog number marked on the outside of the package, and a cable tag containing the heating cable length, wattage, and voltage.

2.4 THERMOSTATS AND CONTACTORS

A. Freeze protection systems shall operate using self-regulating control, the RTAS-X thermostat in ordinary and Division 2 hazardous areas, or the B121 thermostat in Division 1 hazardous areas.

B. Process temperature maintenance system shall operate using the RTBC-X thermostat in ordinary and Division 2 hazardous areas or the E121 thermostat in Division 1 hazardous areas.

C. Chromalox contactor type CONT shall be used where the heat tracing circuit current exceeds the thermostat switch rating. Contactor enclosure type NEMA 1, 4, or 7 shall be used according to enclosure location.

2.5 CONTROL, MONITORING AND POWER DISTRIBUTION SYSTEMS

A. For single or dual loop applications, a UL listed microprocessor-based temperature control, monitoring and power distribution system shall be used. The controller shall accept (2) 100-ohm platinum RTD sensor inputs per circuit. The system shall be compatible with self-regulating and MI cables and shall have the following features.
   1. For single or dual loop applications, a UL listed microprocessor-based temperature control, monitoring and power distribution system shall be used. The controller shall accept (2) 100-ohm platinum RTD sensor inputs per circuit. The system shall be compatible with self-regulating and MI cables and shall have the following features.
      a. NEMA 4X fiberglass enclosure
      b. Supply voltage: (select: 120, 240 or 277 Vac single phase).
      c. Field power connection terminal block must accept (2) RTD sensor inputs per circuit.
      d. Control must operate in 32-104ºF (0-40º C) environments.
      e. Solid state relay rated 40A at 104ºF (40ºC) output.
      f. Optional RS-485 MODBUS communications capable with interfacing with personal computers and PLC's.
      g. Low current alarm: 0-30A in 1A increments.
      h. Optional 5-100mA ground fault alarm trip.
      i. Process, deviation, band, high/low and latching/non-latching (manual/automatic reset) programmable temperature alarms.
      j. On/Off and PID control modes.
      k. Selectable Soft start control mode to eliminate self-regulating cable in-rush current.
      l. High Resolution TFT display for ease of programming and monitoring (single/dual line LCD display is not acceptable)
      m. Separate LED indication for power, load & alarm for each circuit shall be provided on front panel
      n. Controller shall be Chromalox ITC-XX1 for single loop application or ITC-XX2 for dual loop applications.
   2. For multi-loop applications, a UL listed microprocessor-based temperature control, monitoring and power distribution system shall be used. The sensors shall be of the type resistance temperature detector RTD (0 – 500C/32 – 900F) and shall be wired to the panel. The system shall be compatible with self-regulating and MI cables and shall have the following features.
      a. NEMA 4/12 enclosure.
      b. Supply voltage: (select: 120, 208, 220, 240, 277 or 480 Vac single phase).
      c. The system must have a color touch screen operator interface.
      d. Field power connection terminal block and RTD input connection terminal block for (select: 6, 12, 18, 24 or 36 circuits – optional expansion panel in 6, 12, 18, 24 or 36 circuits must be made available).
      e. Select (32-104ºF) (0-40ºC) operating environment without Cabinet Heater) (-40 – 104 F with Optional Cabinet heater).
      f. Solid State Output Relays for each circuit rated 40 Amps.

g. Select (Optional RS-485 MODBUS communications for interfacing with personal computers and PLC's).
h. The system must be capable of checking cable continuity without use of monitor wire.
i. Ground fault alarm must be adjustable between (25 – 500 mA).
j. The system must have selectable capability for ground fault alarm only or ground fault and trip.
k. The system must have Non-Latching, High/low programmable temperature alarms.
l. The system must have Open Sensor Alarm with Programmable Open Sensor Output Setting (0-100%).
m. The System must have capability to graphically display circuit currents.
n. The system must have load managing start-up capability.
o. The system must have user selectable soft start capability.
p. The system must have programmable self-test capability from 0 to 720 hours with full system alarm capability including ground fault, high/low temp and continuity
q. The system must have user selectable control modes including automatic, manual, On/Off Control with adjustable Deadband (1 – 10) or PID control.
r. The system must be field programmable for ºF or ºC.
s. The system must have capability for global programming of all setpoints and alarms.
t. The system must have capability for graphic displays of Loop Status, Alarm conditions, Process Temperature, Setpoints and Currents.
u. The system must have one set of dry alarm contacts.
v. The system must have selectable Hand/Off/Auto control modes.
w. The system must have a control Loop Enable/Disable Feature.
x. The system must have sensor mapping capability such that any sensor can be mapped to control any circuit or combination of circuits via user selection.
y. All features including temperature control, contactors, and power distribution must be contained in one enclosure.
z. The system must be modular in-design, such that individual components can be replaced in the field if necessary.
aa. The system must be UL & cUL approved.

3. Control, Monitoring and Power Distribution Systems shall be IntelliTrace ITLS/ITAS as supplied by Chromalox.

PART 3 – INSTALLATION

3.1 INSTALLATION

A. the system shall be insulted per manufacturers engineering details, isometric drawings, line lists and other pertinent data.
B. The installing contractor shall have a minimum of 5 years' experience installing industrial electric heat trace systems as demonstrated by a manufacturer approved experience list.
C. Installation techniques shall be governed by the manufacturer installation instructions, and the NEC202-2013 Installing and Maintaining Industrial Heat Trace Systems document. In event of conflict the order or precedence is manufacturers design details, manufactures installation instructions and then the NEC202-2013 document.
D. The Installation contractor shall maintain licensed, trained and qualified personnel on site throughout the installation process.
E. Installation schedule shall be defined and agreed to by all parties prior to contactor mobilization.

F. Installer shall provide weekly updates on job completion status including both physical install details and financial reporting.
G. Installer shall conform to all site safety requirements and provide site safety documentation as required.
H. Installer shall keep records of all heating cable installed on site per job requirements – at a minimum circuit number corresponding with heat trace isometric drawing and model number, batch number, reel number and actual footage installed shall be documented on provided heat trace isometrics. Actual location of power connection, end seals and splice/tee boxes shall be indicated on isometric drawings as well. This documentation is required prior to final payment for install services.

END OF SECTION

DIVISION 27 – COMMUNICATIONS

SECTION 271513 – CATEGORY 6 HORIZONTAL UTP RISER CABLE

PART 1 – GENERAL

1.1 SUMMARY

A. SCOPE OF WORK
Category 6 Horizontal Unshielded Twisted Pair (UTP) Riser cable is to be utilized for all ethernet communications cable for this project unless specified otherwise. Several codes and standards apply to the installation and termination of Category 6 Horizontal (UTP) Riser cable. It is the responsibility of the cable installer to follow industry standards to assure proper cable performance and long-term reliability.

1.2 QUALITY ASSURANCE

A. Installation of Category 6 Horizontal UTP Riser cable shall adhere to manufacturer's guidelines.

B. Category 6 Horizontal UTP Riser cable shall be installed according to recognized Category 6 Horizontal UTP Riser installation practices, and applicable codes and standards.

C. Installed Category 6 Horizontal UTP Riser cable shall be manufactured by an ISO 9001-2000 Certified facility.

D. Installed Category 6 Horizontal UTP Riser cable shall be free from defects in material or workmanship from the manufacturer and shall be of the quality indicated.

E. Specified cable is based on acceptable manufacturers listed in the Construction Documents.

F. All methods of construction that are not specified in the contract documents shall be subject to control and approval by the Owner or Owner's Representative.

G. Installed cable shall be lot-traceable by lot number and date of manufacture printed on the outer cable jacket.

H. All critical internal manufacturing operations for Category 6 Horizontal UTP Riser cable shall have documented in-process inspection and testing according to ISO9001-2000.

I. Where "approved equal" is stated, any substitute product shall be equivalent to all requirements specified and is subject to approval.

J. Materials and work specified in this document shall comply with, and are not limited to the standards, codes, and publications listed below:
1. ANSI/TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard (and all published addenda), Part 1: General Requirements, 2001.
2. ANSI/TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard (and all published addenda), Part 2: Balanced Twisted Pair Cabling Components, 2001.
3. National Fire Protection Association, Inc., NFPA 70: National Electric Code (NEC), 2002.
    a) NEC Article 250: Grounding
    b) NEC Article 800: Communications Circuits

4. ANSI J-STD-607A, Commercial Building Grounding and Bonding Requirements for Telecommunications, 2002.
5. ISO/IEC 11801, Ed. 2:2002, Information Technology – Generic Cabling for Customer Premises, 2002.
6. ANSI.TIA/EIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2003.
7. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, 2002.
8. IEEE 802.3af, Data Terminal Equipment (DTE) Power Over Media Dependent Interface (MDI).
9. Underwriter's Laboratory, Inc., UL1863: Standard for Safety – Communications Circuit Accessories, 4th Ed, 2004.
10. Telecommunications Distribution Methods Manual, 10th Ed., Building Industry Consulting Services International (BICSI), 2003.
11. Information Transport Systems Installation Manual, 4th Ed., Building Industry Consulting Services International (BICSI), 2004.

1.3 REFERENCES

A. IEEE 802.3 – 2002, IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems, Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, 2002.

1.4 WARRANTY

A. Product is warranted free of defects in material or workmanship.

B. Product is warranted to perform the intended function within design limits.

C. To obtain the full warranty, the Contractor is to insure the following:
1. Construction is performed by an installer that is certified by the warranty program.
2. Contractors performing the certified installation are properly registered in the warranty program.
3. The link or channel components are supplied entirely by the same manufacturer (including patch cords for channel).
4. Cable used in the installation is qualified and recognized by Manufacturer.
5. Links or channels in the installation are properly documented and tested with a "PASS" result. (See "Field Quality Control – Testing" in PART 3 of this document for testing details).
6. Required test results and project documentation is submitted to the Engineer by the registered contractor.

PART 2 – PRODUCTS

2.1 CATEGORY 6 HORIZONTAL UTP RISER CABLE

A. DESIGN REQUIREMENTS
1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.

2. Conductor diameters shall be 0.57 mm (0.022") ± 0.08 mm (0.003") solid copper.
3. Conductor insulation diameter shall be 0.95 mm (0.037") ± 0.13 mm (.005") flame retardant polyolefin.
4. Nominal outer jacket diameter shall be 5.69 mm (0.224") ± 0.2 mm (0.008") PVC, with a nominal wall thickness of 0.4 mm (0.015").
5. Ripcord shall be directly underneath the outer jacket.
6. Cable shall be marked: "MANUFACTURER'S NAME CATEGORY 6 HORIZONTAL UTP – RISER - - 4 PR 23 AWG C(UL)US CMR – (UL) VERIFIED TO TIA/EIA-568-B.2 - -Z/YY (XXXX) - NNNN".
   a) Frequency of marking shall be every 2.0 ft.
   b) 'Z' represents the month of manufacture.
   c) 'YY' indicates the year of manufacture.
   d) 'NNNN' indicates the sequential footage markers.
   e) 'XXXX' indicates the job number.
   f) 'NNNN' indicates the sequential footage markers.
7. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
8. Color coding of the pairs shall be as follows:
   a) Pair 1: White/Blue; Blue
   b) Pair 2: White/Orange; Orange
   c) Pair 3: White/Green; Green
   d) Pair 4: White/Brown; Brown
9. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.

B. PERFORMANCE REQUIREMENTS

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Worst case electrical performance characteristics shall be as follows:
   a) Characteristic Impedance: 100 ± 15 (0.772-100 MHz)
   b) Maximum Conductor Resistance: 9.38/100 Meters @ 20°C
   c) Maximum Resistance Unbalance: 3%
   d) Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
   e) Maximum Capacitance Unbalance: 330 pF/100 Meters
   f) Maximum Delay Skew: 35 ns/100 Meters
3. The manufacturer shall provide Category 6 Horizontal UTP Riser cable component compliance certificates from third party testing organization upon request.
4. Cable shall be UL and C(UL) listed.
5. Cable shall exceed IEEE 802.3af DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
6. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3ab.
7. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6 Horizontal UTP Riser cable, per the ANSI/TIA/EIA-568-B.2 standard.
8. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with qualified Category 6 Horizontal UTP Riser cable.

C. MANUFACTURERS
1. Belden
2. Commscope
3. Panduit
4. Hubbell Premise Wiring
5. Or Approved Equal

PART 3 – EXECUTION

3.1 PREPARATION

A. Conduit, cable tray, and raceway shall be fully deployed from the TR or TE to each wall plate location according to applicable codes and standards.

B. Metallic horizontal cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607.

3.2 INSTALLATION

A. Pull cable into conduits, and place into raceway or cable tray as specified. Do not exceed 25 Lb pull force per cable. Use appropriate lubricants as required to reduce pulling friction.

B. All exposed wiring shall be installed in surface raceway.

C. All wiring above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.

D. Cable slack and service loops shall be stored properly above the ceiling or under the access floor.

E. Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.

F. Installed cable bend radius shall be greater than 4X cable diameter. Avoid kinking or twisting the cable during installation.

G. Do not over-tighten cable ties, and do not use staples or clamps to anchor cables. Velcro straps are recommended.

H. Recommended spacing of cable supports above the ceiling shall be 48”.

I. Maintain the following clearances from EMI sources:
1. Power cable: 6 in.
2. Florescent lights: 12 in.
3. Transformers and electrical service enclosures: 36 in.

J. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle and shall not make physical contact.

K. Length of each horizontal cable run from the TR to the wall outlet shall not exceed 90 meters.

L. Leave sufficient slack for 90 degree sweeps at all vertical drops.

M. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.

N. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

O. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper ‘shiners”. The installer is responsible to replace damaged cables.

P. Horizontal cables extending from mounted jacks or panels shall maintain a minimum bend radius of at least 4 times the cable diameter.

Q. Firestop all cable penetrations through fire-rated barriers per local codes.

3.3 FIELD QUALITY CONTROL – TESTING

A. Cables are tested in the fully terminated condition, as part of the installed horizontal cabling system. Jacks in the wall outlet, and panels in the TR are to be terminated complete, with faceplates assembled complete and properly mounted.

B. Each link or channel in the horizontal cabling system shall be identified and tested individually, using an industry standard level III tester with correct settings.

C. A “PASS” indication shall be obtained for each channel or link, using a level III tester. The installer is responsible to correct any test failures.

D. Completed test reports shall be submitted per contract requirements. See “Warranty” in Part 1 for provisions of the manufacturer link or channel full coverage warranty.

END OF SECTION

DIVISION 27 – COMMUNICATIONS

SECTION 272130 – DATA COMMUNICATIONS COMPACT SWITCHES AND HUBS

PART 1 – GENERAL

1.1 SUMMARY

A. SCOPE OF WORK

1. This specification is for Managed Compact Ethernet switches. A managed compact Ethernet switch serves as an intelligent device that facilitates the connection and communication between various pieces of networked equipment within the facility. These switches are specifically designed to withstand harsh industrial environments, featuring robustness against vibrations, extreme temperatures, and electromagnetic interference, which are common in such settings. Managed switches offer advanced features that enhance network performance, security, and reliability. These features include the ability to configure, manage, and monitor the network, offering control over how data travels across the network and who has access to it. This includes setting up VLANs (Virtual Local Area Networks) to segment network traffic and improve performance, implementing QoS (Quality of Service) policies to prioritize critical data, such as control signals over less important data, and enabling redundancy protocols like Rapid Spanning Tree Protocol (RSTP) to ensure network reliability and prevent downtime in case of a link failure.

1.2 REFERENCE

A. Agency Certifications
1. UL, CUL, UL-EX LIS, CUL-EX LIS

B. Electrical Noise Immunity:
1. The switch shall conform to the IEC61000-4-2 to 4-6 series of noise specifications as listed below
a) IEC 61000-4-2 Electrostatic Discharge (ESD):
1) Class 3; Criterion B
b) IEC 61000-4-3 Radiated Noise Immunity:
1) 10V/m; Criterion A
c) IEC 61000-4-4 Fast Transients (Burst):
1) Data lines: 1 kV; Criterion A
2) Power supply lines: 2.2 kV; Criterion A
d) IEC 61000-4-5 Surge Voltage:
1) Data lines: 1 kV asymmetrical; Criterion B
2) Power supply lines: 0.5 kV symmetrical/asymmetrical; Criterion B
e) IEC 61000-4-6 Conducted Noise Interference:
1) 10VRMS; Criterion A

C. Emissions
1. The switch shall conform to the emissions specifications as listed below:
a) EN 55011 Noise Emissions:

1) Class A
b) EN 55022 Radio Interference Field:
1) Class A

D. Vibration resistance according to IEC 60068-2-6
1. Operation/Storage/Transport: 5g, 10-150Hz, Criterion 3

E. Free fall according to IEC 60068-2-32
1. 1m height

F. Mechanical shock test according to IEC 60068-2-27
1. Operation: 25g, 11ms period, half-sine shock pulse
2. Storage/Transport: 50g, 11ms period, half-sine shock pulse

PART 2 – PRODUCTS

2.1 GENERAL

A. All wiring, hardware, and connection means shall be in compliance with the National Electrical Code and/or applicable local codes.

B. The Managed Compact Ethernet Switch will be referred to as "switch" or "switches" in this specification.

2.2 MOUNTING

A. The Switch shall be DIN rail mountable out of the box, without the requirement to add or assemble any adaptor or similar mounting plate.

B. DIN rail mounted switches shall be capable of being installed side by side, with no gap or air space required for heat dissipation, with no loss of accuracy.

C. DIN rail mounted switches shall be installed in an approved control cabinet that provides appropriate protection from environmental influences.

2.3 WIRE CONNECTIONS

A. Switch power and alarm connections shall be wired using pluggable connectors

B. All switch connectors shall be clearly labeled to provide easy reference.

C. Pluggable connectors shall be keyed to help prevent incorrect positioning of the plug in the switch.

2.4 EQUIPMENT

A. The managed Ethernet switch shall be IEEE 802.3 compliant.

B. The switch shall be powered by a nominal 24VDC supply.

1. The switch shall have a permissible voltage range of 18.5 VDC to 30.5 VDC

C. Switch shall support redundant power inputs that allow immediate switchover without interruption of switch operation.

D. The switch shall have an operating temperature range of 0°C to +60°C.

E. The permissible storage temperature range for the switch shall be -40°C to +85°C.

F. The switch shall withstand a maximum continuous operating humidity of 95% without condensation.

G. Units should be of fan-less design to increase reliability

H. The switch shall contain 8 copper ports at minimum. Ultimately, each switch at minimum shall contain the proper amount of ports to accommodate all RJ45 connectors required as shown on the contract drawings with an additional spare.

I. Switching Capabilities
1. Auto-negotiation
a) All Copper TX ports shall support auto negotiation
1) Each TX port shall be able to interface to 10/100 Mbps or full/half duplex devices
2) Fiber optic ports shall only support continuous 100 Mbps full duplex communications
2. Auto Cross
a) All TX ports shall support MDIX providing cable autocross capability
3. Auto Polarity
a) The switch shall support automatic port polarity change in the event a pair of twisted pair receive cables (RD+/RD-) are connected incorrectly

I. Diagnostics:
1. Port Status LED's
a) Link: Each port shall have an LED indication that there is a proper electrical connection to the attached device as well as providing indication that there is port activity
b) Communication: Each port shall have an LED indication to showing speed and duplex mode
c) To simplify the process of troubleshooting, the status indication of heavy communications traffic vs. the status of an active link with no communications traffic shall be unambiguous.
2. Alarm Contact
a) The Switch is to be equipped with an alarm contact to enable automatic audible or visual alarm in the event of loss of port communication, or either (or both) power supply inputs
b) Switch to be equipped with an LED to indicate the status of the alarm contact.
3. Power Supply LED
a) Switch shall have a separate power indication LED for each power supply connection.

J. Internal Switch Functions

1. Simple Network Management Protocol (SNMP)
   a) The switch shall support SNMP v1, v2 for network monitoring and configuration
   b) The switch shall operate with any industry MIB browser
   c) Switch shall have a system of fully configurable SNMP Trap messages
2. Device Addressing
   a) The switch shall, by default, support dynamic device addressing via BootP
   b) The switch shall be capable of operation with a static IP address assignment
   c) Support for switch IP address assignment via DHCP shall be available
   d) Switch address can be set via serial port connection
3. Redundancy
4. Rapid Spanning Tree Protocol (RSTP)
   a) The switch shall conform to the IEEE standard 802.1w for redundancy
   b) The switch shall support redundant port connections and loops without causing network operation failure
   c) The system of redundancy shall be applicable for any network topology
   d) Entire redundancy method shall be integral to the individual switch and not dependent upon a separate management device
5. Fast Ring Detection (FRD)
   a) The Switch shall support the RSTP extension Fast Ring Detection to enable data channel recovery times faster than standard RSTP
6. Media Redundancy Protocol (MRP)
   a) Switch shall support MRP in accordance with the IEC protocol 62439
7. Web-Based Management
   a) The switch shall be programmed with an embedded web server
   b) The web server shall provide a comprehensive configuration, and diagnostic mechanism for the switch
8. Security
   a) The switch shall provide the user the ability to entirely disable the Web-based management interface
   b) Switch shall support an IP address-based method for restriction of Web server access
   c) Modifications to switch settings shall be protected by a user selectable/changeable password
   d) The switch shall support an optional MAC address-based mechanism for controlling port access
9. Port Mirroring
   a) The switch shall have the capability to send a copy of all network packets seen on one switch port to a network monitoring connection on another switch port
   b) The switch shall support mirroring of both ingress and egress traffic
10. Firmware Administration
    a) The switch shall be structured so that future functionalities can be added through firmware upgrades
    b) The switch shall have the capability to receive firmware upgrades as a field serviceable process
    c) Firmware upgrades shall be performed via the integrated web server in conjunction with any TFTP server software, or via the serial connection
11. IGMP Snooping and Query

a) The switch shall be capable of passively monitoring IGMP (multicast) messages and dynamically creating appropriate groups for proper message forwarding
b) The query interval and snoop aging times shall be user configurable to up to 60 minutes
c) The switch shall support up to 128 multicast groups

12. Large Ring Networks
    a) The switch shall support a configurable "Large Tree" extension to the Rapid Spanning Tree option, making a ring topology suitable for 28 switches along the relevant path from the Root
    b) This support option shall provide the capability of constructing an RSTP ring topology of up to 57 switches, when all switches are configured with same function
13. Traffic Prioritization
    a) The switch shall support multiple priority queues for adjusting the internal packet processing sequence
    b) The switch shall employ "Strict Priority" for transmitting data telegrams to ensure all high-priority data packets are transmitted
    c) Switch shall have a user settable internal prioritization for individual ports, so that the processing of Ethernet data for a particular port can be optimized
14. Virtual LAN (VLAN)
    a) The switch is able to maintain up to 32 concurrent VLANs
    b) The switch shall support GARP VLAN Registration Protocol (GVRP) for dynamic VLAN implementation
15. Link Layer Discovery Protocol (LLDP)
    a) The switch shall support LLDP according to IEEE 802.1ab, for topology detection of devices that also have LLDP activated
16. DHCP Relay Agent
    a) The switch shall have a DHCP relay agent, with support for option 82
    b) The relay agent function shall be able to be controlled on a per port basis

2.5 MANUFACTURERS

A. Phoenix Contact Inc

B. Or Approved Equal

PART 3 – EXECUTION

3.1 INSTALLERS

A. Installers shall be knowledgeable, and if required, certified, in all applicable electrical practices, standards, code and wiring techniques as they pertain to installing industrial Ethernet switches.

B. Installers shall follow all applicable safety standards and perform work on only de-energized electrical systems.

C. Installers shall follow manufacturer's installation instructions provided with the switch.

END OF SECTION

DIVISION 31 – EARTHWORK

SECTION 312300 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes temporary excavation support and protection systems.

1.2 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
   1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
   2. Prevent surface water from entering excavations by grading, dikes, or other means.
   3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.3 SUBMITTALS

A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
   1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. Qualification Data: For Installer and professional engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
   1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.

2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
   1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches.

E. Shotcrete: Comply with Division 3 Section "Shotcrete" for shotcrete materials and mixes, reinforcing, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
   1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
   1. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER BEAMS AND LAGGING

A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at centers indicated and secure to soldier beams.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
   1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

B. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
   1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Engineer.
   2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
   3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

B. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.

C. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

DIVISION 31 – EARTHWORK

SECTION 312319 – DEWATERING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes
   1. Control of groundwater and surface run-off for construction period.
   2. Discharge of drainage water from construction site.
   3. Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operations.

1.2 DEFINITIONS

A. Subgrade: Surface to which excavations are necessarily made for the purpose of construction of the Work in accordance with the Contract Documents. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain desired foundation conditions.

1.3 SYSTEM DESCRIPTION

A. Design and Performance Requirements
   1. Design, construct, and maintain a dewatering system.
   2. Install and operate dewatering systems, in coordination with the design and construction of excavation shoring systems, excavation and backfilling operations, to meet performance requirements.
   3. Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation. Do not allow silt laden run-off water to enter water courses. Direct runoff flows to siltation ponds or catchment areas.
   4. Dewater and keep excavations free of water to permit placing geotexiles, granular filter blankets, underdrains, granular construction working surface, concrete, and similar items, on firm dry subgrade.
   5. Maintain groundwater level a minimum of 12 inches below the subgrade or lower as may be required to fulfill the requirements of the specifications.
   6. Prevent destabilization, heaving and shear failure of the bottom of excavation by depressurizing and dewatering groundwater.
   7. Prevent damage to or displacement of structures from groundwater pressures.
   8. Maintain groundwater a minimum of 12 inches below the subgrade until backfilling to final grade has been completed and underdrains and other permanent devices, which protect the structures against buoyancy are operational. Where designed self weight of structure resists the buoyancy forces, make sure that the structure is completely built before allowing groundwater level to rise.
   9. Obtain the Engineer’s written consent prior to allowing a rise in groundwater level or prior to shutting down the dewatering operation.
   10. Repair or replace any structure or Works damaged due to dewatering at no expense to the Owner.

B. Dewatering Discharge Requirements

1. Provide appropriate filter screens so that no soil or foundation material is removed.
2. Provide a discharge siltation pond, or similar method, of required size to allow sufficient detention time so that the decanted water will meet state regulations. Discharge water from run-off collection and dewatering operations to a siltation pond located on site as directed by the Engineer.
3. Maintain siltation pond during construction period by removing silt buildup from time to time to keep siltation pond functional.
4. The Owner will carry out chemical analysis of drainage water to establish conformance with state regulations. If required, treat the drainage water to meet the state regulation before discharging into a watercourse.
5. Discharge drainage water to existing water courses or storm drainage system. If discharging to water course, prevent erosion of existing banks.

1.4 SUBMITTALS

A. Shop Drawings
   1. Submit a general plan of dewatering scheme which includes:
      a. Location of generators and other noise producing equipment and anticipated decibel levels.
      b. Relationship between dewatering equipment, new structures, and the excavation plan.
      c. Location of dewatering discharge points.
      d. Location and dimensions of siltation pond.
      e. Details of screens and filter media.
   2. These submittals are for record purposes only and will not be reviewed for adequacy.

B. Dewatering Equipment Approval
   1. Apply and obtain dewatering equipment approval from local conservation authority if required.

C. Dewatering Discharge Approval
   1. Apply and obtain dewatering discharge approval from local conservation authority if required.

1.5 QUALITY ASSURANCE

A. Qualifications
   1. Specialist dewatering contractor who has a minimum of 8 years experience in the design and construction of dewatering systems for projects of similar size and complexity.

1.6 SITE CONDITIONS

A. Soils Report
   1. Refer to information Available to Bidders.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Dewatering Equipment

1. Pipes, wells, deep wells, well points, pumps, electrical generators, and other equipment.
2. Standby pumps and a generator with effective muffling devices to keep noise levels to a minimum.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Dewatering Equipment
   1. Install dewatering equipment and dewater to required level before proceeding to excavate below groundwater level.
   2. Take corrective measures to maintain groundwater level at a sufficiently low level to meet performance requirements.

B. Subexcavation
   1. When directed by the Engineer to subexcavate because of unsuitable subgrade condition, dewater and monitor effectiveness of dewatering before proceeding to excavate.

C. Flotation of Structures
   1. Maintain groundwater at a sufficiently low level to prevent damage or displacement of structures by groundwater pressures.
   2. Protect completed structures or part of completed structures which would suffer displacement or other damage as a result of dewatering equipment failure by providing:
      a. Standby dewatering equipment connected directly to electrical generators, engaging automatically in case of power failure.
      b. A positive means by which the structures may be flooded with water to neutralize exterior hydraulic pressures.
      c. A combination of the two alternatives above.

3.2 FIELD QUALITY CONTROL

A. Monitoring Groundwater Level (If necessary)
   1. Take readings of groundwater level two times a day for the duration of the dewatering period. Keep a written record of groundwater levels.

END OF SECTION

DIVISION 31 - EARTHWORK

SECTION 312333 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavating trenches for utilities and site piping.

B. Backfilling and compaction of utility and site piping trenches.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T 99, Moisture-Density Relations of Soils, Using a 5.5-lb Rammer and a 12-inch Drop.
   2. AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand Cone Method.

B. American Society for Testing and Materials:
   1. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
   2. ASTM D1556 - Test method for Density and Unit Weight of Soil in Place by Sand Cone Method.
   3. ASTM D 2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
   4. ASTM D2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
   5. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
   7. ASTM D4643 - Test Method for Determination of Water Moisture Content of Soil by the Microwave Oven Method

C. Ohio Department of Transportation:

1.3 DEFINITIONS

A. Definitions:
   1. Rock Excavation: Removal of consolidated hard mineral material mass exceeding one-half cubic yard in volume which, cannot be excavated except by drilling and blasting or drilling and wedging. Structure foundations of concrete or of masonry or stone laid in cement-mortar is classified as rock if the volume requiring removal at a single location exceeds one-half cubic yard. No soft or disintegrated rock which can be removed with a pick, or material which can be broken down by sledge hammers, or a ledge or single boulder less than one-half cubic yard in volume, or loose, shaken, or broken stone in rock filling or elsewhere, or rock exterior to the line of measurement as hereinafter specified, will be allowed as rock.

2. Subgrade: Trench bottom prepared as specified to receive first class bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.
3. Utility: Any buried pipe, duct, conduit or cable.
4. Final Surfacing Elevation: Elevation of bottom of final surfacing operation such as bottom of topsoil depth or paving subgrade.

1.4 SUBMITTALS

A. Samples: Submit aggregate samples when requested by Engineer and other required submissions to the Engineer's field office.

B. Test Reports:
1. Submit testing laboratory aggregate test reports based on requirements stated in Source Quality Control.
2. Compaction density test reports based on method of density determination as specified in Reference Standards and the method as approved by the Engineer.

C. Certificates: Submit certificate from aggregate supplier based on requirements stated in Source Quality Control, when requested by Engineer.

D. Bonds and Licenses: Submit evidence of bonds, licenses, and experience prior to commencement of any blasting operations.

1.5 QUALITY ASSURANCE

A. Source Quality Control:
1. Laboratory Tests: In accordance with Section 014000, aggregate materials specified herein under Products require advance examination or testing according to methods referenced, or as required by the Engineer.
   a. Testing laboratory shall furnish both Engineer and Contractor two copies of test result reports. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
   b. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such materials.
   c. The Engineer reserves the right to accept aggregate materials based on certification from supplier that the aggregate originates from a source approved by ODOT and that the aggregate complies with specified ODOT requirements.

B. Regulatory Requirements
1. Work performed within Owner’s property or rights-of-ways shall be completed according to all requirements of the Owner.

1.6 PROJECT CONDITIONS

A. Classification of Excavated Materials: Consideration will not be given to the nature of the materials encountered in trenching operations or for difficulties encountered during excavating or handling of materials. But, if rock, as defined, is encountered in trenching operations, immediate notification of the Owner/Engineer must be made. Records of the amount of rock encountered must be kept in a manner approved by the Owner/Engineer and submitted for records.

B. Removal of Obstructions:
1. Remove, realign or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of the Engineer. Perform such work as extra work unless such work is done by the Owner of the obstruction without cost to the Contractor. However, Contractor shall uncover and sustain the obstruction at own expense

prior to the final disposition of obstruction. The Contractor is not entitled to claims for damage or extra compensation due to the presence of such obstruction or delay in the removal or rearrangement of same. Additional precautions concerning obstructions as follows:

a. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or structures, but allow said persons, firms, corporations or utilities to take such measures as they may consider necessary or advisable under the circumstances; which shall not relieve the responsibilities of the Contract.

b. Without extra compensation, break through and reconstruct if necessary, the invert or arch of a sewer, culvert or conduit that may be encountered if the said structure is in such a position, in the judgment of the Engineer, as not to require its removal, realignment or complete reconstruction.

C. Environmental Requirements:

1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of the Engineer, that work cannot be performed satisfactorily.
2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
4. Plan work so as to provide adequate protection during storms with provisions available for preventing flood damage. Protect installed piping and other work against damage from uplift due to high ground water levels.
5. Accommodation of Drainage: Keep gutters, sewers, drains and ditches open for surface drainage. No damming or ponding or water in gutters or other waterways will be permitted, except where stream crossings are necessary and then only to an extent which the Engineer shall consider necessary. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as required, and place the same as required at no expense to the Owner. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.
6. Pumping: Keep excavations free from water during the performance of the work under this Contract at no expense to the Owner. Build dams and other devices necessary for this purpose and provide and operate pumps of sufficient capacity for dewatering the excavations. Provide for the disposal of the water removed from excavations in such manner as not to cause injury to the public health, to public or private property, to the work of others, to the portion of the work completed or in progress or produce an impediment to the use of streets, roads and highways.
7. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials caused by hauling on roadways.
8. Provide effective dust and mud control.
9. Do not dispose of water in trenches by draining through completed portions of sewer piping.

D. Protection: Assume the risks attending and presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work for same, existing structures and property of whatever nature. Damages and expenses for direct or indirect injury to such structures or to any person or property by reason of them or by reason of injury to them; whether such structures are or are not shown on the Drawings, by work of this Contract, rests solely with the Contractor.

1. Outside Trenching Area: Take necessary precautions to protect trees, shrubs, lawns and such other landscaping from damage. Complete restitution work for damages at no additional cost to Owner.

2. Pipe Supports: Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along their entire exposed length. Install such supports in such manner that backfilling may be performed without dislodging such pipes or conduits. Place and carefully compact Aggregate Backfill around the supports and leave such supports in place as a guard against breakage due to backfill settlement. No additional payment will be due the Contractor for support material left in place or for the labor of installing and maintaining supports.
3. Temporary Protective Construction:
    a. Temporary Fence Barricade: Erect and maintain substantial temporary fences surrounding excavation to prevent unauthorized persons from entering such areas.
    b. Barricades: Furnish and erect substantial barricades at crossings of trenches, or along trenches, to protect the traveling public.
    c. Excavation Covers: Cover open excavation when work therein is suspended or left unattended, including the end of a work day. For such covers, use materials of sufficient strength and weight to prevent their removal by unauthorized persons.
    d. Remove temporary protective construction at the completion of work on the Project.
    e. Comply with Owner and OH DOT requirements.

E. Structure Supports: Where passing buildings or any structure which by their construction or position might bring a great pressure upon the trenches, the right is reserved by the Engineer to require that such buildings or structures be underpinned or supported and protected, or special sheeting be driven or that short lengths of trench be opened at one time. Failure of Engineer to recommend said protection shall not relieve Contractor of his responsibility to protect structures near the construction.

F. Accommodation of Traffic: (Comply with the requirements of Section 01500.) DO NOT OBSTRUCT FIRE HYDRANTS. Employ traffic control measures in accordance with ODOT, Title 67, Chapter 203.

G. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements, remove by the use of mechanical surface impact equipment, or by drilling and hydraulic rock splitting equipment, or by other methods.

H. Responsibility for Condition of Excavation: Condition and results of excavation are solely the responsibility of the Contractor. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.

I. Excess Materials: No right of property in materials is granted to the Contractor of excavated materials prior to backfilling. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials.

J. Borrow Material: When the required quantity of backfill material exceeds the quantity of suitable on site material, provide borrow material. If borrow material is needed, notify the Engineer sufficiently in advance to permit the Engineer to verify such need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to the Engineer's approval whose written consent shall be obtained prior to its use. Contractor shall be responsible for all sampling and testing required by Engineer to determine suitability.

K. Change of Trench Location or Depth:
1. Should the Engineer require a change in location of a trench from that indicated on the Drawings due to the presence of an obstruction, or from other cause and such change is made before the excavation is begun, the Contractor shall not be entitled to extra compensation or to a claim for damages.

2. The Contractor shall have no claim for additional compensation as a result of changes in trench depths or locations.
3. If a changed location of a trench is authorized by the Engineer upon the Contractor's request, the Contractor shall not be entitled to extra compensation or to a claim for damage. If such change of trench location involves the abandonment of excavation already made, the abandoned excavation and backfill shall be at the Contractor's expense.

L. Advance Trenching: Where existing Utilities or other suspected underground obstructions as indicated on the Drawings are within close proximity of proposed pipelines, uncover and verify the exact location of Utilities and other underground obstructions far enough in advance of pipe laying to allow any changes in pipe alignment or grade required to bypass the obstructions to avoid removing sections of pipe already installed. If any sections of installed pipe must be removed and reinstalled as a result of not verifying Utilities or other underground obstructions far enough in advance, the Contractor shall remove and reinstall the pipe at no additional cost to Owner.

1.7 COORDINATION

A. Coordinate work under provisions of Sections 011000.

B. Verify work associated with lower elevation Utilities is complete before placing higher elevation Utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Backfill
1. Suitable Trench Backfill Material: On site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal and refuse; and free of rock or similar hard objects larger than six inches in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.
2. Clean Organic Material Backfill: One site excavated material free of vegetation, lumber, metal and refuse, and free of rocks or similar hard objects larger than one inch in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.
3. Aggregate Backfill: ODOT Coarse Aggregate.
4. Select Material Backfill: material conforming with ODOT.

B. Pipe Bedding
1. First Class Bedding: Coarse Aggregate conforming to ODOT.
   a. For piping having a diameter of 24 inches and less use AASHTO No. 8 Coarse Aggregate.
   b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.
2. Initial Backfill: Coarse Aggregate conforming to ODOT.
   a. For piping having a diameter of 24 inches and less, use AASHTO No. 8 Coarse Aggregate.
   b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.
   c. For ductile iron piping, use clean earth backfill or, if aggregate backfill is required, use aggregate backfill.

C. Concrete Cradle and Encasement: Conforming to Section 033000 - Cast-in-Place Concrete with a 28-day compressive strength of 3,000 psi.

D. Unsuitable Bearing Material: AASHTO No. 3 Coarse Aggregate conforming to ODOT.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities which are to remain.

3.2 EXCAVATING

A. Perform soil erosion and sedimentation control work in accordance with the approved Erosion and Sedimentation Control Plan.

B. General:
1. Excavation shall be performed to the lines and grades indicated on the Drawings or as directed by the Engineer.
2. Perform excavation and backfilling using machinery except where hand excavation and backfilling is required or is necessary to protect existing structures, utilities, or other private or public properties.
3. Begin excavation in trenches at the control point having the lower invert and proceed upward.
4. Remove rock to subgrade at least twenty-five (25) feet in advance of pipe laying.
5. Do not interfere with 45 degree bearing splay of foundations.

C. Subgrade Preparation:
1. Do not excavate below depths indicated or specified except where unsuitable material is encountered at subgrade.
2. Remove unsuitable material found below subgrade to a depth determined by Engineer and backfill with Unsuitable Bearing Replacement material or as directed by Engineer to required Subgrade.
3. Remove rocks or other hard matter protruding through trench bottom at Subgrade which could damage pipe or impede consistent backfilling or compaction. Backfill with first class bedding to required Subgrade. Compact in four (4) inch lifts.
4. Remove rock below subgrade if shattered due to excessive drilling impact or splitting operations and in the opinion of the Engineer it is unfit for foundations. Backfill to Subgrade with Concrete or other material acceptable to the Engineer. No separate or additional payment will be made for such removal and backfill.

D. Excavated Material Storage:
1. Separate and stockpile in designated area, excavated materials suitable for use as backfill. Remove from the site, excess materials and excavated materials not suitable for backfill.
2. In no case shall excavated materials be stockpiled outside of the construction easements or the permanent right-of-way if construction easements are not in place.

E. Trench Width:
1. From subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines and not less than the minimum nor

more than the maximum widths specified in Table A. If shoring is required, the following Table A dimensions apply to the inside face of sheeting.

TABLE A

Diameter of Pipe	Min. Trench Width (Outside Diameter of Pipe at the Barrel Plus)	Max. Trench Width (Outside Diameter of Pipe at the Barrel Plus)
4 through 24 inches	12 inches	16 inches
27 through 36 inches	20 inches	24 inches
42 through 72 inches	26 inches	30 inches
Larger than 72 inches	30 inches	36 inches

2. From a point twelve inches above the top of the outside barrel of the pipe, maintain trench banks as follows:
   a. Vertical as possible for trenches in paved or unpaved roadways.
   b. In open areas, trenches may be sloped at angles required to make trench stand, however, in no case shall angle exceed one-half horizontal to one vertical.
   c. Top of trench shall not exceed limits of right of way or construction easement if such is in place.
   d. Maintain trenches such that there is no conflict with State or OSHA regulations.

F. Length of Open Trench:
   1. Complete trench excavation at least twenty-five (25) feet but not more than one hundred (100) feet in advance of pipe laying and keep trenches free from obstructions, except that at the end of a work day or at the discontinuance of work, the pipe laying may be completed to within five feet of the end of the open trench.
   2. The Contractor shall limit all trench openings to a distance commensurate with all rules of safety.
   3. If the work is stopped either totally or partially, the Contractor shall refill the trench and temporarily repave over the same at his expense. The trench shall not be opened until he is ready to proceed with the construction of the pipeline.
   4. Engineer reserves the right to request trench refilling over completed pipe if in his judgment, such action is necessary. No claim for extra compensation will be allowed for such refilling even though work may be stopped elsewhere as a result.

3.3 PIPE BEDDING

A. Place Pipe Bedding and Initial Backfill as specified herein unless indicated otherwise on Drawings. Place material in trench for full width. Place on each side of pipe and fittings simultaneously.

B. First Class Bedding: Carefully place on undisturbed subgrade or compacted subgrade as approved by the Engineer, pipe bedding material from six (6) inches below outside of pipe barrel to pipe springline. Work pipe bedding material by hand under pipe haunching to provide adequate side support. Place in three (3) inch layers.

C. Initial Backfill: From pipe springline to twelve (12) inches above outside of pipe barrel carefully place initial backfill in four (4) inch layers. Place carefully so as not to disturb pipe.

3.4 BACKFILL

A. Backfill trenches to contours and elevations indicated on Drawings.

B. Maintain optimum moisture content of fill materials to attain required compaction density.

C. Do not use frozen backfill materials or place backfill on frozen subgrades or trench subgrades.

D. Perform backfilling by methods which will result in thorough compaction of backfill material.

E. Backfill to Final Restoration Elevation: Backfill from one (1) foot above the top of pipe to Final Surface Subgrade Elevation using backfill materials specified in Schedule at end of this Section. Consolidate backfill materials evenly from center to side of trench to prevent arching.

F. If there is a deficiency of backfill material, provide borrow material as required at no additional cost to Owner

3.5 COMPACTION

A. Solidly tamp each layer of bedding around the pipeline and above pipeline using proper tamping tools made especially for this purpose. Compact each layer to the densities specified in the Schedule contained at the end of this Section using ASTM D698 Standard Proctor Test Methods determined at maximum density at optimum moisture content as determined by AASHTO T 99.

B. Do not use rolling equipment or heavy tampers to consolidate backfill until at least two (2) feet of backfill is placed over the top of the pipe.

C. The use of HYDRA-HAMMER for compacting backfill in trenches is prohibited.

D. The use of puddling or jetting for compacting backfill in trenches is prohibited.

E. Compaction Tests: During the course of backfilling and compacting, the Owner/Engineer will at various locations and depths of trenches request that the Contractor make field tests to verify that specified compactions are being achieved. Perform field density tests according to AASHTO T 191 or ASTM D2922 and ASTM D3017. At a minimum, the following will apply:
   1. One compaction test shall be performed at every two vertical feet of backfill every 200 linear feet in roadways, paved areas, and driveways, etc.

   2. One compaction test shall be performed at every four vertical feet of backfill every 500 linear feet in all other areas.

F. Compaction Requirements: Compaction of backfill materials are specified in Schedule at end of this Section.

G. If compaction tests indicate that Work does not meet specified requirements, remove Work, replace, compact and retest at no additional cost to the Owner.

3.6 CLEAN-UP AND MAINTENANCE

A. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition. Streets shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates.

B. Remove surplus excavated materials, rubbish and other construction debris from the site after backfilling is completed.

C. Construction site shall be left clean at end of each working day to satisfaction of Engineer.

END OF SECTION

BACKFILL AND COMPACTION SCHEDULE

Location	Backfill Material	Compaction Required
All trenches and excavation	Suitable Material	100%

DIVISION 31 - EARTHWORK

SECTION 312500 – STORMWATER POLLUTION PREVENTION PLAN

PART 1 - GENERAL

1.1 STORMWATER POLLUTION PREVENTION PLAN

A. Description: This section of the specification shall serve as a supplement to the Stormwater Pollution Prevention Plan for the Project.
   1. This plan together with the accompanying exhibits were developed by RETTEW Associates, Inc.
   2. This plan was intended to be developed in accordance with the requirements of the Erosion and Sediment Control Manual published by the Ohio Department of Environmental Protection, Bureau of Soil and Water Conservation.
   3. This plan consists of the narrative as contained in this section and details contained on the drawings.

B. Details and locations as indicated and shown on the contract drawings.

C. Purpose: The purpose of this Stormwater Pollution Prevention Plan is to provide the Contractor with general guidelines as well as specific techniques for minimizing erosion and sedimentation and stormwater pollution during and after construction of the project.

D. Project location is Wooster, Wayne County, Ohio, as shown on the Project Location Map.

E. The Owner is the City of Wooster

F. Anticipated dates of construction are February 2024 through February 2025.

G. Additional controls may be required at problem areas that develop during construction above and beyond those that are described in this narrative.

1.3 QUALITY ASSURANCE

A. Regulatory agency requirements.
   1. The Contractor is advised that all work will be completed in compliance with the requirements of this plan and the rules and regulations of the Ohio Department of Environmental Protection and the Wayne County Conservation District. Any fines and associated costs resulting from the Contractor's failure to provide adequate protection against soil erosion and sedimentation shall be borne by the Contractor.
   2. Upon the anticipated initiation of construction, the Contractor's program for carrying out this plan will be reviewed in the field with representatives of the Wayne County Conservation District, the Contractor, the Owner, and the Engineer.

1.4 SUBMITTALS

A. If the Contractor anticipates any work which is not as shown on the plans and specifications (such as associated with spoil or borrow areas) the Contractor shall prepare and submit for approval an appropriate Stormwater Pollution Prevention Plan for that work. Such plan shall receive the approval of the Wayne County Conservation District prior to the start of earth moving activities in those areas.

1.5 STORMWATER POLLUTION PREVENTION PLAN NARRATIVE (See Enclosed Stormwater Pollution Prevention Plan on Project Drawings)

PART 2 - PRODUCTS

2.1 MATERIALS (See Enclosed Stormwater Pollution Prevention Plan)

PART 3 - EXECUTION

3.1 PREPARATION (See Enclosed Stormwater Pollution Prevention Plan)

3.2 INSTALLATION (See Enclosed Stormwater Pollution Prevention Plan)

3.3 MAINTENANCE (See Enclosed Stormwater Pollution Prevention Plan)

END OF SECTION

DIVISION 31 - EARTHWORK

SECTION 315000 - EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavation, backfill and compaction requirements for buildings and other site structures.

B. Excavation, backfill and compaction requirements for general site.

C. Site grading.

1.2 DEFINITIONS

A. Excavation: Removal of all materials of any kind or nature encountered in completion of the Work, including rock, to the elevations required and subsequent disposal of materials removed.

B. Subgrade: Areas upon which the planned bottoms of foundations, footers, slabs, paving base courses, sidewalks or additional materials including topsoil shall rest; or if foundation fill or subbase is to be utilized beneath a structure, the surface upon which the foundation fill or subbase shall rest.

C. Fill: Material required to bring the proposed finished grades above the existing grades.

D. Random Backfill: Non-select material required to replace material excavated for the purpose of constructing site structures.

E. Structure Backfill: Select open-graded, free-draining material for use in backfilling against structure walls.

F. Foundation Fill: Structure fill material to be utilized beneath structure foundations, where required to replace unsuitable soil or rock encountered.

G Subbase: Compacted aggregate material utilized under sidewalks, slabs-on-grade, and paving sections.

1.3 REFERENCES

A. ASTM D698-00a Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

B. ANSI/ASTM D1556- Test methods for density of soil in place by the sand-cone method.

C. ASTM D2922- Test methods for density of soil and soil-aggregate in place by nuclear methods (Shallow Depth).

D. ASTM D3017-01 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

E. Ohio Department of Transportation (ODOT) Specifications.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.
   3. Laboratory compaction curve according to ASTM D 1557 for each aggregate material proposed for fill and backfill.
   4. Density test reports for subgrades, fills and backfills.

B. Comply with applicable requirements of NFPA 495, "Explosive Materials Code."

C. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experience in seismic surveys and blasting procedures to perform the following services:
   1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring services during blasting operations.

D. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.5 QUALITY ASSURANCE

A. Source Quality Control
   1. Independent Laboratory Tests: Furnish Engineer two copies of test result reports.

B. Aggregate Material Test
   1. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such material.
   2. All aggregate material must be certified from supplier that the aggregate originates from a source approved by OH DOT and that the aggregate complies with specified OH DOT requirements.

C. Field Quality Control
   1. All field quality control testing must be supervised by a Professional Engineer.

1.6 JOB CONDITIONS

A. Unclassified Excavation: No consideration will be given to the nature of materials encountered in excavating operations for structures. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of materials.

B. Borrow Excavation: If the required quantity of backfill exceeds the quantity of suitable material excavated within the limits of the project site and rights-of-way, obtain sufficient material to complete the backfill at no additional cost to OWNER. If borrow excavation is needed, notify ENGINEER sufficiently in advance of borrow excavation requirements to permit ENGINEER to verify the need for such borrow excavation and to view the proposed borrow pit and determine the suitability of the material to be provided. Use of borrow excavation from offsite must be approved by ENGINEER. Any tests required by ENGINEER to assist in determining suitability of the borrow materials shall be responsibility of CONTRACTOR and completed at no increase in Contract Price.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subbase Material: Coarse aggregate consisting of naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or crushed slag meeting the requirements of ODOT or AASHTO 57.

B. Foundation Fill: Evenly graded mixture of crushed stone or crushed or uncrushed gravel meeting the requirements of ODOT or AASHTO 57.

C. Random Backfill and Fill Materials: Suitable material conforming to the requirements of ODOT, reasonably free of organic matter such as leaves, grass, roots, sod, sewage, coal or coal blossom, or other unsuitable material. Frozen material shall not be utilized.

D. Structure Backfill: Open-graded coarse aggregate meeting the requirements of ODOT for AASHTO No. 57.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform shoring and bracing in accordance with the requirements of Section 312300.

3.2 REQUIREMENTS AND RESTRICTIONS

A. Keep excavations free from water. Comply with Section 312319
   1. If required, lower water table below excavation bottom by deep wells, well points and pumping. Initiate dewatering activities sufficiently in advance of excavating to stabilize groundwater table in area of excavation below excavation bottom, prior to starting any excavating. Provide and operate pumps of sufficient capacity for dewatering the excavations. Dispose of water removed from excavations in a manner that will not cause injury to the public health, to public or private property, to the work of other contractors, to any portion of the Work completed or in progress, or to produce impediment to the use of highways, roads, lanes and streets by the public. No additional payment will be made for pumping or other difficulties encountered due to water.

B. Maintain sewers, drains and ditches free of debris to convey surface drainage. No damming or ponding of water in gutters or other waterways will be permitted. Do not direct flow of water across pavements except through approved pipes or properly constructed troughs. Provide pipes or troughs of such sizes and lengths as may be required. Control grading in the vicinity of excavations so the ground surface is properly pitched to prevent water from running into excavated areas.

C. Control groundwater and surface water during construction in order to maintain soil stability. Maintain the water table elevation sufficiently below the levels of excavations that slopes will remain stable and bottoms of excavations will not become loosened by flow of water. If the foundation material loses its strength due to improper dewatering techniques, overexcavate the material and replace it with Foundation Fill at no additional cost to OWNER.

D. Do not perform excavating, backfilling or compacting when weather conditions or the condition of materials are such, that in the opinion of ENGINEER, the Work cannot be completed in accordance with the Specifications.

E. Do not use as backfill or fill, frozen materials or wet materials containing moisture in excess of the amount necessary for satisfactory compaction.

F. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.

G. Prevent spread of dust during performance of work by thoroughly moistening excavation areas by sprinkling or other methods approved by ENGINEER.

H. No right of ownership of excavated materials is granted to CONTRACTOR prior to backfilling. This provision does not relieve CONTRACTOR of his responsibility to remove and dispose of surplus excavated material. Excess excavated material that cannot be used at the site shall be removed and disposed of in a legal manner at no additional expense to OWNER.

I. Assume sole responsibility for the condition and results of excavations. Slides and cave-ins shall be removed without additional compensation at whatever time and under whatever circumstances they may occur.

J. Protect all pipes, conduits, walls, buildings and other structures or property whether above or below ground, or that may appear in the excavation. Maintain sufficient quantity of material and equipment on the site and for use as necessary for sheeting, sustaining and supporting any pipes, conduits, walls, building, structure or property.

3.3 EXPLOSIVES

A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
   1. Do not damage adjacent structures, property, or site improvements or weaken the bearing capacity of rock subgrade when using explosives.

3.4 EXCAVATION

A. General Procedures:
   1. Perform excavation using machinery, except where hand excavation may be required to protect existing structures, process piping, plant conduits, utilities or private or public properties. No additional compensation will be paid for hand excavation instead of machine excavation as may be necessary from any cause whatever.
   2. Perform excavation of every description and of whatever substances encountered to the elevations indicated by the Drawings and as specified herein.
   3. Where work space is limited, remove excavated material from the limited area and replace the material after the work has been completed. No additional compensation will be made for such removal and replacement of the excavated material.
   4. Extend excavation a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

B. Remove rock that has been shattered due to rock removal operations and in the opinion of ENGINEER is unfit for foundations to an elevation below subgrade. Fill to subgrade with Foundation Fill those areas where shattered rock has been removed. Perform such backfilling to the satisfaction of ENGINEER. No separate or additional payment will be made for such removal and backfill.

C. Excavation Below Planned Subgrade:
   1. Do not excavate below depths indicated on the Drawings or such depths as required for the proper installation of the Work, unless otherwise directed by ENGINEER.
   2. Excavation below depths indicated on the Drawings or as required for the proper installation of the Work through the fault of the CONTRACTOR, shall be restored to the indicated or required depths with Foundation Fill at the expense of CONTRACTOR.
   3. If the foundation for any structure is required by ENGINEER to be carried lower than the planned subgrade elevation, the overexcavation shall be backfilled up to planned subgrade elevation with Foundation Fill. Payment for this additional work will be made in accordance with the applicable General Provisions.

D. Storage of Approved Materials:
   1. Store on site all unused approved materials.
   2. Do not mix unused approved materials of differing types.
   3. Do not mix unused approved materials with unapproved materials.

3.5 SUBGRADE PREPARATION

A. General Procedures:
   1. Where subgrade consists of an excavated soil surface, thoroughly machine-tamp the existing material. Compact the exposed soils until no movement is observed or as directed by the ENGINEER. Remove and replace soft, loose, and disturbed zones disclosed by the tamping. Overexcavate to the depth directed by ENGINEER and replace with Foundation Fill; compact as indicated in these specifications.
   2. Where subgrade consists of an elevated fill surface, compact the fill as indicated elsewhere in these specifications. Shape the surface to the required lines and grades.
   3. Where subgrade consists of an excavated rock surface, thoroughly inspect the bedrock bearing surfaces, and clean any exposed soil-filled seams with water jets or compressed air to a minimum depth of two (2) times the seam width. Fill the open joints with concrete during placement of the structure foundation.
   4. If Foundation Fill is indicated on the Drawings or required by these specifications, or if required to replace unsuitable material as directed in the field by the ENGINEER, place the material uniformly and without segregation of coarse and fine material. Place the material in maximum 12-inch lifts and compact with vibratory equipment. Satisfactory compaction will be based on non-movement of the material.

B. Approval of Subgrade
   1. Notify Geotechnical Engineer when excavations have reached required subgrade.
   2. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   3. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
   4. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

3.6 BACKFILLING

A. General Procedures:

1. Perform backfilling using machinery, except where hand backfilling is required to prevent damage to walls, foundations, utilities, plant conduits or process piping. No additional compensation will be paid where backfilling by hand is required.
2. Remove any trash and debris from excavation prior to backfilling.
3. Do not place backfill material prior to seven days after completion of structure walls, and then only if the concrete or mortar has achieved 80% of the specified 28-day compressive strength.
4. Do not place backfill material on wet or frozen areas.
5. Do not operate heavy equipment closer to walls than a distance equal to the height of backfill material above the top of the structure footing.
6. Do not place backfill material against exterior walls until supporting floors, other reinforcing or supporting members, or slabs at top of walls are in place.
7. Do not place backfill material against water containing concrete structures or manholes until water testing has been satisfactorily completed.
8. Perform compaction using power driven tampers or compactors suitable for material being placed.

B. Random Backfill:
1. Use random backfill where structure backfill is not required or specified. Use of structure backfill in lieu of random backfill is allowed.
2. Place random backfill in loose, uniform horizontal layers not exceeding eight inches in depth.
3. Maintain moisture content of random backfill at compaction within two percent of optimum moisture as determined by ASTM D 698.
4. Compact random backfill to at least 95 percent of the maximum dry-weight density based on ASTM D 698.

C. Structure Backfill:
1. Place structure backfill behind all structure walls if indicated on the drawings. Place structure backfill in 8-inch lifts and thoroughly compact each lift with a vibratory compactor to the satisfaction of ENGINEER.

3.7 EMBANKMENTS AND FILLS

A. Where fill is required to raise the subgrade to the elevations indicated on the Drawings, such fills shall be made with suitable materials, equipment, and workmanship, and under control and supervision of an approved testing laboratory. Where such fills exceed 8 inches in depth, the fill shall be constructed before proceeding with work on the subgrade.

B. Testing: Include in Bid Price costs for performing all laboratory and field compaction tests necessary to insure an adequate fill of uniform quality. Prior to commencing fill work, laboratory tests shall be performed based on ASTM D1557 on the material to be used to establish the compacted dry weight at optimum moisture. Results shall be submitted to ENGINEER for approval. Field tests of moisture content prior to compaction and dry weight after compaction shall be made and submitted to ENGINEER for approval; one set of these tests shall be made for each 100 square yards of each layer; additional tests shall be made if soil or moisture conditions change; results of tests shall be submitted to ENGINEER.

C. Construction
1. Area to be filled shall be cleared of all loose material and inspected and approved by ENGINEER. The surface shall then be loosened to a depth of at least 4 inches and satisfactorily compacted. Fill material shall be free from frost and shall not be placed on frozen ground. It shall be deposited in layers of such thickness as required by the nature of the soil or as directed, but the uncompacted thickness of each layer shall not exceed 8 inches. Each layer shall be separately compacted to a uniform solid mass by machine rolling or other approved means. Fill shall be placed in horizontal layers, beginning with the lowest areas and building

up until the entire areas to be filled is at a uniform elevation. CONTRACTOR shall control the moisture content of the fill material, to insure maximum density by either the addition of water, or by harrowing and working the soil prior to compacting. Each layer shall be free of ruts and shall meet compaction requirements before a succeeding layer is placed. Compaction of each layer shall continue until no weaving or creeping takes place.

2. Field tests of moisture content prior to compaction and density after compaction shall be made to insure thorough and uniform compaction. One set of the latter tests shall be made for each 200 square yards of each layer. Additional tests shall be made if soil or moisture conditions change.

D. Required Compaction Results
   1. All fills under concrete floor slabs or areas for vehicular traffic shall be compacted to not less than 100% of the maximum dry-weight density at optimum moisture as specified above.
   2. All other fills or embankments shall be compacted to not less than 95% of the maximum dry-weight density at optimum moisture as specified above.
   3. Whenever in-place density, according to the tests noted above, is found to be below acceptable limits, additional compaction will be required to produce the specified density, as shown by additional tests.

E. Required Grading Tolerances
   1. Foundations: ±0.02 feet of indicated grade
   2. Vehicular Traffic Areas: ±0.10 feet of indicated grade
   3. Topsoiled Areas: ±0.15 feet of indicated grade
   4. Swales or Stormwater Management Areas: ±0.10 feet of indicated grade

3.8 SUBBASE

A. General:
   1. Do not place subbase material on soft, muddy, or frozen subgrades. Satisfactorily correct irregularities or soft zones in the prepared area.

B. Placement and Compaction:
   1. Place subbase material in maximum 8" lifts. When using ODOT compactable material, compact to 100% of the maximum dry-weight density. When using ODOT non-compactable material, satisfactory compaction will be based on non-movement of the material.

3. 9 FIELD QUALITY CONTROL

A. Testing
   1. ENGINEER shall inspect and approve subgrades and fill layers before further construction work is performed. CONTRACTOR shall have field density tests performed in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. If methods of ASTM D 2922 are used for density testing, moisture content must be determined by ASTM D 3017.
   2. All testing to be completed by independent testing agency.
   3. Soil Subgrades for Structure Foundations: For each strata of soil on which footing or foundation will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing or foundation subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
   4. Subgrades and Subbase for Floor Slabs on Grade and Areas for Vehicular Traffic: Make at least one field density test of subgrade and subbase for every 200 sq. ft. of paved area or floor slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 200 sq. ft. of overlaying building slab, but in no case less than 3 tests.

5. Subgrades and subbase for Other Areas: Make at least one field density test of subgrade and subbase for every 500 ft. of embankment for each 1.5 feet elevation lift, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 500 sq. ft. of overlaying building slab, but in no case less than 3 tests.
6. Random Backfill: Take at least 2 field density tests per lift, when applicable, at locations and elevations as directed.

B. Corrective Measures:
1. Whenever tests indicate that the field moisture or density does not meet specified requirements, take corrective action as approved by ENGINEER.
2. Corrective measures may include loosening the soil and wetting or drying it prior to recompaction, additional compaction, or removing and replacing the material.
3. Retest material that did not meet the moisture and density requirements after corrective measures have been performed.

C. Retesting: ENGINEER may at any time require retesting of any material, whether in stockpiles or being placed, if it appears that the material differs from that which has previously been approved for use.

D. Surface Tolerance:
1. Check finished subgrade for smoothness and elevation in accordance with the following:
a. Use approved template conforming the required design requirement indicated on the Drawings for checking crown, contour and sideslopes.
b. Use approved 10-foot straight edge to check longitudinal irregularities in the subgrade.
c. Use string lines for controlling the finished elevation.

2. Corrective Measures:
a. Whenever tests indicate the surface tolerances does not meet the requirements, take corrective action as approved by ENGINEER.
b. Corrective measures may include scarifying soil or aggregate, removing excess material, filling low spots, reshaping and compacting to the required surface.
c. Retest material (including moisture and compaction) that did not meet the surface tolerance after corrective measures have been performed.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.

B. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

DIVISION 40 – PROCESS INTERCONNECTIONS

SECTION 402300 - PROCESS PIPING, VALVES, AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract Documents including General and Supplementary Conditions and Division 01 specifications sections apply to all work in this section.

1.2 GENERAL

A. This section covers furnishing, installing, and testing (where required), all piping, tubing, fittings, valves, insulation, accessories and supports, etc., with the exception of any piping which is an integral part of any equipment assembly and which would be furnished by the manufacturer.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).
   1. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

B. American National Standards Institute (ANSI).
   1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.
   2. ANSI B31.1 – Power Piping.

C. American Welding Society (AWS).
   1. AWS B2.1 – Standard for Welding Procedure and Performance Qualifications.

D. American Water Works Association (AWWA)
   1. AWWA Manual M11 – Steel Pipe – A Guide for Design and Installation

E. American Society of Mechanical Engineers (ASME).

F. Underwriters Laboratories (UL).

G. Factory Mutual (FM).

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 SUBMITTALS

A. Submit under Division 01.

B. Shop Drawings and Product Data:
   1. Piping layouts in full detail
   2. Location of pipe hangers and supports.
   3. Large scale details of wall penetrations and fabricated fittings.
   4. Schedules of all pipe fittings, special castings, couplings, expansion joints and other appurtenances.
   5. Catalog cuts of pipe, valve joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.
   6. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Certificates:
   1. Copies of certification for all welders performing Work in accordance with ANSI B31.1.

D. Manufacturer's installation (or application) instructions.

E. The CONTRACTOR shall be cognizant of the service and design features such as support anchoring, expansion/contraction, and jointing of the piping and valves he proposes to utilize. He shall inform the ENGINEER of any features which are not compatible with the drawings at the time such equipment is submitted for approval.

F. The drawings do not necessarily show the design and placement of supports, guides, and anchors. The CONTRACTOR is responsible for the placement and type of all pipe supports, guides, and anchors to prevent excessive movement or damage to the pipe due to expansion/contraction or pump start/stop. The CONTRACTOR shall submit shop drawings illustrating this information.

1.5 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gauge above atmospheric pressure (psig) and all temperatures are expressed in degrees Fahrenheit (F).

1.6 DELIVERY STORAGE AND HANDLING

A. During loading, transportation and unloading take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

B. Packing and Shipping:
   1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed that is found to be defective. Any damage to the coatings shall be repaired as acceptable to the ENGINEER.
   2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.
      a. All valves 3-inches and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
      b. Valves smaller than 3-inches shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
      c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
      d. Any corrosion in evidence at the time of acceptance by the OWNER shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection
   1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer’s information for further requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems shown on the drawings. It shall be the responsibility of the CONTRACTOR to develop final details and any details associated with special conditions not already covered to meet the system conditions (in particular system temperatures and pressures) specified in the respective Division 46 Sections.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to

adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces and all probable external forces such as equipment, pipe and personnel contact.

C. The CONTRACTOR may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the Work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

D. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

E. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.

F. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

G. All uninsulated non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by galvanized steel protection shields or other method as approved by the ENGINEER. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U bolts, protection shields shall be provided for the entire pipe circumference. Protection shields shall have an 18-gauge minimum thickness, not be less than 12-inches in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than ½-inch wide.

H. Pipe supports shall be provided as follows:
1. Insofar as is possible, ceiling or wall supports shall be given preference.
2. Support spacing for steel and stainless-steel piping 2-inches and smaller diameter.
3. For all stainless-steel piping, provide neoprene isolators between the pipe and support components.
4. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-ft. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy; the Globetray by the Metal Products, a Division of United States Gypsum, or equal. Ladder shall be of galvanized steel construction. Rung spacing shall be 12-inches. Tray width shall be approximately 6-inches for single runs and 12-inches for double runs. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR or equal. Spacing between clamps shall not exceed 9-ft. The cable trays shall provide continuous support along the length of the pipe. Individual

clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

5. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

I. Any required pipe supports for which the supports specified in this section are not applicable shall be fabricated or constructed from standard structural steel shapes, concrete and anchor hardware similar to items previously specified herein and shall be subject to the approval of the ENGINEER.

J. Expansion anchors shall be equal to Kwik-Bolt as manufactured by the Hilti USA or Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the steel reinforcement.

K. Hanger rods shall be hot rolled steel, machine threaded and galvanized after fabrication. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S, Figures 180, 571 or 150; or continuous concrete inserts per F&S. Inserts shall be malleable iron, or steel with galvanized finish. Beam clamps, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the ENGINEER, expansion anchors shall be used for attaching to concrete structures.

2.2 PIPING AND TUBING MATERIALS

A. Ductile Iron Pipe (DIP)

1. The CONTRACTOR shall furnish, install, join and test all ductile iron pressure pipe, cast iron and ductile iron fittings, special castings, and appurtenant materials and equipment, all as indicated on the drawings and as hereinafter specified.
2. Fittings shall be cast iron or ductile iron. Coatings shall be same as pipeline.
   a. Fittings for ductile iron piping shall be as follows:

3” thru 12” pipe size:	Class 250 Gray Iron or Class 350 Ductile Iron
14” thru 24” pipe size:	Class 150 Gray Iron or Class 350 Ductile Iron
30” thru 48” pipe size:	Class 150 Gray Iron or Class 250 Ductile Iron

   b. All pressure ductile iron pipe and cast-iron fittings using flanges shall be furnished as Class 53.
   c. Joints for ductile iron pipe and cast-iron fittings shall be flanged, mechanical joint or mechanically coupled grooved joint as indicated on the drawings and as specified in "Joining of Pipes" in this division. Boltless restraining joints are acceptable.
3. Standard Specifications
   a. All pipe, fittings and accessories shall conform to the requirements of the following standard specifications, or the latest revisions as applicable:

ANSI A.21.4	Standard for Cement-Mortar Lining for Ductile Iron Pipe Iron Fittings for Water.

ANSI A.21.10	Standard for Cast Iron Fittings 3 inches through 48 inches, for Water and other Liquids
ANSI A.21.11	Standard for Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings
ANSI A.21.50	Standard for the Thickness Design of Ductile-Iron Pressure Pipe and Fittings.
ANSI A.21.51	Standard for Ductile Iron Pipe, Centrifically Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI C-606	Standard for Joints, Grooved and Shouldered Type Fittings.
ANSI B.16.1	Standard for Cast Iron Pipe Flanges and Flanged Fittings 25, 125, 250 and 800 lb.
C115/A.21.15	Standard for Flanged Ductile Iron and Gray Iron Pipe Threaded Flanges.
ANSI	Standard for Joints, Grooved and Shouldered Type Fittings.

4. Lining and Coating
   a. All ductile iron pipe and cast-iron fittings shall be lined and coated as follows:
      1) The inside shall be given a standard thickness cement lining and an asphaltic seal coat in accordance with ANSI A21.4.
      2) The outside of underground systems shall be coated with the standard bituminous coating specified under the appropriate ANSI specifications for the pipe and fittings.
      3) Machined surfaces shall be cleaned and coated with a rust-preventive coating at the shop immediately after being machined.
5. Inspection and Testing
   a. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The CONTRACTOR shall furnish duplicate to the OWNER'S Representative sworn certificates of such tests. All inspection and testing at the foundry shall be accomplished at no additional expense to the OWNER.
   b. Pipes and fittings shall be subjected to a careful inspection and hammer test just before being installed.

B. PVC Pipe
1. PVC pipe shall be rigid, Type I, Grade I, ANSI/ASTM D-1784, D-1785 polyvinyl chloride Schedule 80 pipe, and shall be as manufactured by Ethyl Corp., Valley Industrial Plastics, Monaca, PA; or R & G Sloane, Sun Valley, CA.
2. Pipe shall be manufactured in accordance with U.S. Department of Commerce Commercial Standard CS-207-60 and ANSI/ASTM Designation D-543.
3. Pipe shall contain less than 10% inert fillers.
4. All pipe shall be jointed by solvent cement, socket fittings or flanged fittings. Where threaded pipe must be used, it shall be threaded with new threading dies which shall not be used for the threading of iron pipe or other metal pipe. Piping and fittings must be manufactured by the same company.

C. Stainless Steel Pipe and Fittings (SS)
1. Biogas Piping and Tubing – Shall be class 150, ASTM A312 Type 316 stainless steel.

a. thicknesses:

Nominal Pipe Size	Schedule/Gauge
½" to 30" (non-threaded)	10S
½" to 2" (threaded)	40S

b. Tubing shall comply with ASTM A269 with the following wall thicknesses:

Nominal Pipe Size	Schedule/Gauge
¼" to 3"	#16 Gauge
4"	#14 Gauge
6", 8"	#12 Gauge
10", 12"	#10 Gauge

2. All stainless-steel pipe shall conform to the requirements of ASTM A778 and ASTM A530, and shall be hydrostatically tested to the pressures indicated in that specification.
3. Pipe shall be shop fabricated. Field welding will not be permitted without written permission of the OWNER'S Representative. If field welding is required, Type 316L stainless steel shall be used.
4. Fittings
   a. Fittings shall be butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Long radius elbows up to 24" diameter shall be smooth flow. All short radius, special radius, and reducing elbows and long radius elbows greater than 24" diameter shall be of mitered construction. Reducers shall be straight tapered, cone type. Tees, crosses, laterals and wyes shall be shop fabricated from pipe.
3. Couplings
   a. The piping shall be shop prepared for pipe couplings where shown on the drawings or specified.
4. Flanges
   a. Flanged pipe ends shall be ANSI Class 150 type 304L or 316 stainless steel (depending on biogas or non-biogas service) meeting ASME B16.5, weld-neck type.
   b. Flanges shall be provided as a minimum requirement at all flanged valves, meters, couplings, and other equipment.
   c. All other joints required for shipping, handling and installation of the piping spools shall be field welds or as specified.
   d. Gaskets shall be 1/8" thick Neoprene.
5. Inspection and Testing
   a. All pipe and fittings shall be inspected and tested in accordance with applicable ASTM Specifications. Certified copies of the reports of inspection and testing as required by the ASTM Specification shall be submitted for all pipe and fittings furnished before final acceptance. All inspection and testing shall be accomplished at no additional expense to the OWNER.

2.3 VALVES

A. General

1. Provide all valves as specified herein and as shown on the drawings. Submit for approval by the ENGINEER, a schedule of all valves indicating the service, size, and connections, make, model number and any special features such as chain wheel operators, etc.
2. All packing, gaskets, discs, seats, plugs diaphragms, lubricants, etc., shall conform to recommendations of the valve manufacturer for the intended service.
3. Valves shall be installed with the stems positioned in the horizontal or above the centerline of the pipe. Operators shall be positioned so that they do not interfere with pedestrian traffic. In passageways or above platforms the minimum clearance between the floor and the lowest protruding point on the valve or operator shall be 6 ft 8 in. All valves shall be accessible for operation, maintenance or removal. Valves shall be arranged to open counterclockwise by handwheel or lever operation unless otherwise indicated in these specifications. Valves 4" size and larger which are 7 ft. 0 in. or more above the operating floor or platform shall be chain wheel operated. Where necessary for operations as described above valves shall be bevel or spur gear operated. Plug valves 6 in. and larger shall be gear operated.
4. All valves shall be manufacturer's standard of the design which the manufacturer recommends for the service intended. Each valve shall bear the maker's name or trademark or reference symbol to indicate the service conditions for which it is guaranteed. All valves for use with copper tubing shall have solder type connections. All screw end valves shall be threaded according to the American Standard for Pipe Threads No. B2.1. Flange end valves shall have connecting end flanges in accordance with the B16.1, Class 125 Series of the American Standards Association for type valves covered in the Standard, and in accordance with the Manufacturer's Standardization Society Standard Practice for bronze valves corresponding to the maximum pressure and service for which the valve is to be used.
5. Spare Parts and Tools: Repair or service parts for one of each type and size of valve used in this Work shall be furnished and stored as directed by Engineer. The equipment shall include, in general, the following items: special tools required for maintenance, including seat replacement, or operation of valves, gaskets, rings, seals, lubricants, bolts, washers, and miscellaneous accessories required to maintain valves in proper operating service.
6. Unless otherwise stated in the specifications, or unavailable from the manufacturer, the valve operating mechanisms shall be supplied by the valve manufacturer. This shall include handwheels, levers, gear boxes, and pneumatic electric operators and positioners. The available torque shall be greater than twice the normal turning torque and shall also be greater than the seating or unseating torque.

B. Ball Valves

1. Bronze
   a. Ball, 150 lb, threaded or solder ends. Bronze body, Buna-N seals, chrome plated brass ball.
   b. 2" and smaller
   c. The following manufacturer’s list is provided for convenience. Substitutions require OWNER Representatives’ approval.

1) Crane, New York, NY
2) Watts Regulator Co., Lawrence, MA
3) Apollo, Pageland, SC;
4) Hammond, Hammond, IN
5) Stockham, Birmingham, AL

2. PVC
   a. Ball, socket or flanged
   b. Normal impact PVC, self-lubricating seats
   c. True Union
   d. Safe block design to allow disassembly on downstream side while upstream side remains pressurized.
   e. EPDM "O" ring
   f. The following manufacturer's list is provided for convenience. Substitutions require OWNER Representatives' approval.
      The following manufacture
      1) Nibco/Chemtrol, Louisville, KY
      2) Hayward, Elizabeth, NJ
      3) G.F. Plastics, Tustin, CA
      4) Asahi/America, Medford, MA
3. Stainless Steel
   a. 2-Piece, Full Port
   b. ASTM A351, Gr CF8M stainless steel body and ball
   c. Type 316 Stainless steel stem
   d. Reinforced PTFE seat
   e. Watts Series S-FBV-1 or equal

C. Butterfly Valves
1. Liquid Service Valves - All butterfly valves for liquid service, unless otherwise noted on the drawings or specified, shall be of the tight-closing, rubber seat type with rubber seats that are securely fastened to the valve body or valve disc. Seats shall be fastened with stainless steel hardware, and with a stainless steel mating seat or surface and stainless steel shaft. Valves shall be bubble-tight at rated pressures with flow in either direction. All butterfly valves shall meet the full requirements of AWWA C504, latest revision, for Class 150B and shall be as manufactured by the Henry Pratt Company, Kennedy Valve Corporation, or equal.
2. Gas Service – Valves shall be high-performance, resilient seated with uninterrupted seat and lug or flanged ends, Class 150, meeting API 609 standard.
   a. Body shall be ductile iron with 316 stainless steel disc.
   b. Seat shall be EPDM
   c. Bi-directional, bubble-tight shutoff
   d. Valve shall be DeZURIK BOZ-US or equal.

D. Plug Valve
1. Eccentric plug, 150 lb ANSI flanged or mechanical joint as required
2. Semi-steel, ANSI/ASTM 126 Grade B, resilient Buna-N or Neoprene sealing surface, self-lubricating corrosion resistant bearings
3. Stem seal replaceable under pressure
4. Seats of welded in 90% nickel or fusion bonded Nylon 11
5. Gear operator 4-inches and above
6. Maximum diameter of handwheel shall not exceed twice the diameter of the gear sector.

7. Valves shall have 100% port opening.
8. Packing shall be adjustable
9. All valves shall be given a factory performance test which shall include seat and stem leakage test and shutoff test.
10. Manufacturer to have minimum five (5) year installation experience and submit test results showing compliance with ANSI/AWWA C504
    a. DeZurik, Sartell, MN; (118)
    b. M&H Valve, Anniston, AL
    c. Clow, Oskaloosa, IA
    d. Kennedy, Elmira, NY

E. Check Valves:
1. Unless otherwise specified, check valves 3-inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be manufactured by Jenkins Bros. Corp., Crane Company, or equal.
2. Check valves larger than 3-inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi and shall be manufactured by G.A. Industries, Tyco, or approved equal.

F. Pressure Regulating Valves: Pressure reducing and regulating vales (water services) ½-inch and under shall be bronze and above ½-inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range of differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be as manufactured by Fisher Controls, WATTS, GA, or approved equal.

2.4 PIPING APPURTENANCES & ACCESSORIES

A. Valve Tags: Provide brass identifications tags for all valves in accordance with the valve list furnished by the ENGINEER. Tags shall have stamped numerals painted black and secured with plastic tie wrap to the valve bonnet.
1. Acceptable manufacturers: Seton Name Plate Corp.; McMaster-Carr Supply Co., or equal.

B. Plugs and Caps:
1. Unless otherwise specified, check valves 3-inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be manufactured by Jenkins Bros. Corp., Crane Company, or equal.
2. Plug or cap or otherwise cover all piping work in progress.

C. Unions

1. Unions shall be installed as required for the isolation of all traps, screwed control valves, and connections to screwed equipment unless shown otherwise of the drawings.
2. Unions in piping 2 in. and smaller shall be ground joint, malleable iron, screwed; 125 psig working pressure.
3. Connection in piping 2-1/2 in. and larger shall be flanged type with gaskets designed for the working pressure of the unions.
4. PVC unions shall be manufactured by Hayward Manufacturing Company, Elizabeth, NJ, or Celanese Corp., New York, NY.

D. Wall Penetration Closure

1. Provide wall penetration closures. The closure shall be "Link-Seal" as manufactured by Thunderline Corporation, Wayne, MI. Seals shall be modular mechanical type consisting of synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The closure shall be watertight when bolts are tightened. Inside diameter of wall opening shall be sized as recommended by the manufacturer to assure a watertight joint. Wall sleeves are also available from Thunderline Corporation.

2.5 MANUAL VALVE OPERATORS

A. Manual operators except where noted otherwise herein, all interior valves shall be handwheel or lever operated if the centerline of the valve is 6 feet or less above the floor or platform from which it is to be operated and chain operated if the distance is greater than 6 feet.

B. Nut operators shall have standard 2-inch square AWWA operating nuts and shall be provided where specified or shown on the Drawings. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Nut operators shall be designed to produce the required operating torque with a maximum input of 150 ft.-lb. Handwheels on valves 4 inches and larger shall not be less than 12 inches in diameter.

C. Manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification.

D. Quarter turn operators shall be equipped with adjustable AWWA input limit stops and shall require a minimum of 15 turns for 90° or full stem valve travel and shall be equipped with a valve position indicator.

E. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

F. Manual operators on buried service valves shall be specially constructed for buried service. Buried service operators shall be permanently lubricated and watertight under an external water pressure of 10 psi. Unless otherwise shown or specified, buried service operators shall be furnished with Standard AWWA nut operator and valve box. Where required, a standard

2-inch AWWA nut operator and valve box shall be provided within 6 inches of grade with a steel extension stem-equal to or greater than the diameter of the manual activator shaft.

G. Worn gear operators shall be as manufactured by AUMA, Philadelphia Gear Co., or equal.

2.6 ELECTRICAL OPERATORS FOR OPEN-CLOSE TYPE VALVES

A. Electric operators for open-close type valves shall be Auma, Limitorque, Rotork, or equal. Operators shall be electric motor operated and shall drive the valves through a worm gear operator and intermediate link. Cycle time shall be a maximum of 60 seconds. Operators shall be furnished complete with valves by the valve by the valve supplier.

B. Operator motors shall be reversible squirrel cage induction type suitable for voltage indicated on the Drawings or as otherwise required, 60 hertz operation. Motors shall be totally enclosed, non-ventilated, with NEMA Class B insulation and a maximum continuous temperature rating of 120°C (rise plus ambient). Leads from the motor shall be brought to the limit switch compartment without external piping or conduit box. Operators shall have full voltage NEMA rated integral reversing starters and integral phase discriminators.

C. Operators shall be provided with space heaters in the switch compartment and strip heaters in the motor.

D. Operator gearing shall consist of heat-treated alloy steel helical gears and pinions, high-strength alloy steel worm and high tensile strength bronze worm gear. Operator shall have stem nut of high tensile bronze. Roller or ball bearings shall be used throughout.

E. Design shall assure complete grease coverage of gearing in the mounting position of each operator. Operator shall be double reduction unit with the capability of quickly changing output speed with a simple gear change. A hammer blow feature shall be included, which shall allow attainment of full motor speed before torque is applied to valve.

F. Operator shall be equipped with declutch mechanism and handwheel operator for manual operation. When operator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when operator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation. Operators shall be self-locking with non-back driving stem nuts.

G. A mechanical dial indicator shall be provided on the operator to indicate valve position.

H. The operators shall have 12 contactor limit switches and gearing as an integral part of the operator. Limit switch gearing shall be of the intermittent type, totally enclosed in its own gear case and grease lubricated. Gearing shall be of bronze.

I. Limit switches shall be rated at 5 amperes and shall be wired to a terminal board for remote output. Limit switches shall be adjustable to trip at any point between fully opened and fully closed position.

J. Torque switches shall be provided, responsive to high torque encountered in either direction of operation, and shall reset only after receiving reverse signal at the operator. Torque switch shall operate throughout the complete cycle of operator movement.

K. Operators shall respond to remote 3-wire control signals, with the open signal being a contact closure across the "open" and common terminals, and the close signal a contact closure across the "close" and the common terminals. Latching circuits in the operator shall cause the operator to drive the valve to its limit of travel upon receipt of the open or close signal.

L. Operators shall be furnished with Local-Off-Remote selector switch and push buttons for local control. Three push buttons for local manual operation shall be provided, and shall be marked "open", "stop", and "close". Operator shall drive valve to its limit of travel when "open" or "close" push buttons are depressed.

M. All wire leads for power and control signals shall be brought to a terminal board for field connection. Wiring, switches, relays, etc., shall be provided in a NEMA 4X weatherproof enclosure.

2.7 JOINING OF PIPES

A. General
1. The joining of Pipes shall be in accordance with the system acceptable and recommended by the manufacturer of the piping system. The joining methods herein described are a guide.
2. Threaded piping connections for plastic pipe are not to be used. In the connection of plastic pipe to a metal pipe, flanged connections shall be used.

B. Threaded Joints
1. Pipe screw threads to conform to ANSI B2.1. Ream pipe ends and remove all burrs and chips after cutting and threading. Protect pipe thread during assembly. Apply Teflon tape thread lubricant to male threads.

C. Flanged Joints.
1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanges and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Flanged joints shall be made with bolts, bolt studs with nut on each end, or studs with nuts where flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.
3. Bolting for services up to 500 degrees F shall be ANSI/ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts". Bolt studs and studs shall be of the same quality as machine bolts.
4. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts such that those 180 degrees apart or directly opposite are torqued in sequence.
5. Gaskets for flat face flanges shall be full face type. Gaskets for raise face flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Gaskets 12 in. in diameter and smaller shall be 1/16 in. thick and of following types:

a. Water, Sewage, Sludges (up to 175 degrees Fahrenheit): Red rubber, heavy duty type, by John Crane Co., Morton Grove, IL.
b. Chemical feed, Teflon coated type by John Crane, free flow with neoprene insert.

D. Mechanical Coupled Grooved Joints
1. Mechanical coupling connections shall mechanically engage, lock and seal the grooved pipe ends in a positive couple. Each coupling shall consist of malleable iron housing clamps in two or more C-shaped composition sealing gaskets, designed such that internal pressure tends to increase the tightness of the seal and two or more track-head steel bolts. The entire installation, including pipe grooving, shall be accomplished in accordance with the manufacturer's published instructions. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
2. Approved manufacturers are Gustin Bacon Div. of Aeroquip Corp., Lawrence, KS, (Style 100 with Type 1 gaskets) and Victualic Company of America, South Plainfield, NJ, (Style 31 with flush seal gaskets for cast iron and ductile iron pipe).
3. Couplings used for the accommodation of drop nipples, branches, gauges, or other male threaded connections shall be Style 96 FIT reducing tee, as manufactured by Victaulic Company of America, South Plainfield, NJ, or approved equal.

E. PVC Pipe
1. The following procedures are recommended for the assembly of solvent cement welded PVC pipe and fittings:
a. Cut the pipe ends to be fitted square and smooth.
b. Where the pipe diameter is too large to fit in the socket of fittings, use emery cloth to remove excess material.
c. Wipe end of pipe and sockets of fitting lightly with a cloth moistened with methylethyl ketone to clean off dirt; grease and other foreign materials.
d. Apply a coat of solvent cement to both ends of pipe and socket of fittings by means of a paint brush made of natural (hog) bristle.
e. Insert pipe in socket and press to bottom of socket, then rotate the pipe in socket about one-quarter to one-half turn. A check that sufficient cement has been applied is indicated when a full fillet forms between the pipe and the edge of the socket.
f. Joints may be tested with water after four hours under pressure not exceeding ten percent of the rating. Full working pressure may be applied after joints have been allowed to stand for at least two days.
2. The use of solvent alone, such as methylethyl ketone, as differentiated from solvent cement discussed above, will not be allowed because of the uneven and relatively large clearance between the spigot and the socket, hence the inability to affect a proper and continuous adhesion between all surfaces involved.
3. Where flanged PVC is used, gaskets shall be used in all cases. All fittings shall be of the molded type.

F. Welded Joints

1. Codes and Standards
a. The latest issue of the following codes and standards shall be applicable to welding of piping:
1) American Standard Association (ANSI-B31.1)

2) American Society of Mechanical Engineers (ASME)
3) American Society for Testing and Materials (ASTM)
4) American Welding Society (AWS)
5) Applicable State and Local Regulating Codes covering this Work.

2. Materials
   a. All materials shall be new and unused. Welding rods for acetylene welding shall be ANSI/AWS A5.2 Class No. GA60. Welding rods for metal arc welding shall be ANSI/AWS A5.1, Class E6010 series.
   b. For gas welding, the rods selected shall produce welds whose physical characteristics are not less than the parent metal.
   c. For electric arc welding, the electrode shall be heavily coated or shielded type. Lightly coated or bar electrodes shall not be used. Coated rods shall be protected from moisture damage. They shall be stored in heated cabinets until ready for use.
3. Qualifications of Welders
   a. The CONTRACTOR shall use an organization for welding familiar with ASA31.1 and AWS B3.0 and be capable of supervising the welding and installation.
   b. Welders assigned to the Work shall be duly qualified in accordance with ASME Section IX Boiler and Pressure Vessel Code for Welder's Qualification Test, Welding Procedures and Quality Requirements, and Procedures and Tests for Qualifying Welders. Qualification proof shall be available on request of the OWNER'S representative.
4. Preparation of Metal
   a. The base metal may be prepared for welding by shearing, gas cutting, etc. Metal shall be cleaned of grease, oil, paint, rust, scale, burrs, pipe cuttings or anything else which may be detrimental to the finished weld.
5. Welding Methods
   a. No welding shall be done if the metal temperature is below 0°F or if the surfaces are wet. Between 0°F and 32°F the metal shall be heated until warm to the hand.
   b. In the installation of socket weld fittings and valves a 1/16" clearance shall be left between the end of the pipe and the shoulder in the socket.
   c. Butt welds shall be prepared with welding grooves by machining or flame cutting and grinding. Ends shall be leveled to a 37-1/2° (maximum angle), leaving a 1/16-inch land on the bottom of the welding edge. A minimum 3/32-inch separation shall be allowed between the lands. (A 1/16-inch separation shall be used for gas welding.)
   d. The two pieces shall be held for welding by alignment fixtures. Tack welds in the grooves may be used if fixtures cannot be used but shall be kept to a minimum.
   e. The number of passes for welding joints and the method of welding shall be sufficient to satisfy good practice and pressure requirements specified. The average thickness of each layer of welding metal shall not exceed 1/8". Complete fusion shall be obtained and care shall be taken that full penetration is obtained through thickness of metal without stalactite or dripping. All slag and flux shall be removed by wire brushing before each succeeding pass is made. The completed weld shall be free from all defects including undercutting, porosity and cracking. Welds shall present a smooth, regular workmanship appearance.

2.7 PIPE INSULATION

A. All piping shall be insulated where indicated on the Plans. Insulation thickness per the following schedule:

Nominal Pipe Size	Insulation Thickness
½" to 3"	1"
4" to 12"	2"

B. Manufacturers:
1. Owens Corning
2. Or equal

C. General
1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
2. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795

D. Molded Fibrous Glass Pipe Insulation: Comply with ASTM C547, Type I, Grade A; and Type IV, Grade B; and ASTM C585, for sizes required and of a type suitable for installation on piping systems as required.
1. Owens Corning ® SSL II® with ASJ Max FIBERGLAS™ Pipe Insulation.
2. Owens Corning® Large Diameter FIBERGLAS™ Pipe Insulation. With SSL I closure and ASJ Max jacket.
3. Owens Corning® No-Wrap Pipe Insulation.

E. Field-Applied Jackets
1. Valves of bonnetless knife gate type with wafer face-to-face flanged connections. General: Field-applied jackets shall comply with ASTM C1136; Type I or Type II.
   a. At Below-Ambient Temperatures: Type I.
   b. At Above-Ambient Temperatures: Type II, where a vapor barrier is not required.
2. PVC Jackets: ASTM D1784, Class 16354-C; 0.020 in thick PVC jacketing and fitting covers.
   a. Acceptable Manufacturer: Proto Corp.
3. Aluminum Jackets: ASTM C1729, Class A, 0.016 in thick aluminum jacket with 3 mil thick polyfilm moisture barrier factory-heat- laminated to the interior surface.
   a. Acceptable Manufacturer: ITW Insulation Systems
4. Stainless Steel Jackets: ASTM C1767, Class A, minimum 0.010 in thick stainless steel jacket with 3 mil thick polyfilm moisture barrier factory-heat-laminated to the interior surface.

F. Accessory Materials
1. Accessories: Provide accessories per insulating system manufacturer's recommendations, including the following:
   a. Closure Materials: Butt strips, bands, wires, staples, mastics, adhesives, and pressure-sensitive tapes.

1) Mold resistant mastics are required recommended for chilled water applications.

b. Field-Applied Jacketing Materials: Sheet metal, plastic, canvas, fiberglass cloth, insulating cement, PVC fitting covers.

c. Support Materials: Hanger straps, hanger rods, saddles, support rings, and high-density inserts.

2. Adhesives for Indoor Applications: VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 PIPE SUPPORTS

A. Unless otherwise indicated on the drawings, maximum spacing of pipe supports for horizontal runs shall be as follows:

PIPE SUPPORTS

Pipe Material	Maximum Spacing, Liquid
Steel (std weight or heavier), Ductile Iron, cast iron	
1½" and under	7'.0"
2", 2½", 3"	10'-0"
4", 5", 6"	14'-0"
8" , 10"	20'-0"
12" and above	As indicated on drawings
PVC, Plastic Pipe, Flexible Hose, Soft Copper Tubing	
2" and under	Continuous support
2½" and above required	As shown on drawings or as by manufacturer for service temperature.

B. Provide additional supports, a) where pipe changes direction, b) adjacent to flanged valves and strainers, and c) at equipment connections and heavy fittings.

C. Pipe supports shall be provided as follows:

1. Insofar as is possible, ceiling or wall supports shall be given preference.
2. Support spacing for steel and stainless steel piping 2-inches and smaller diameter and copper tubing shall not exceed 5-ft.
3. For all stainless-steel piping, provide neoprene isolators between the pipe and support components.
4. Supports for multiple PVC plastic piping shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-ft. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Ladder Cable Tray by MP Husky; the Globetray by GS Metals, or equal. Ladder shall be of galvanized steel construction. Rung spacing shall be 12-inches. Tray width shall be approximately 6-inches for single runs and 12-inches for double runs. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe; MP Huskey or equal. Spacing between clamps shall not exceed 9-ft. The cable trays shall provide continuous support along the length of the pipe.

Individual clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

5. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

D. Couplings

1. All couplings on ductile iron pipe shall be Style 38 couplings as manufactured by Dresser Industries, Bradford, PA. Couplings to have steel middle ring, flanges, track head and rolled thread bolts. Two rubber compounded wedge section gaskets to tightly seal and reset cold flow of the pipe shall be furnished with each coupling. Style 440 Joint Harnesses shall be used except as noted otherwise. Lugs and bolts shall be in accordance with the manufacturer's selection for line working pressure and pipe size. Similar couplings by Rockwell International, Pittsburgh, PA or approved equal will be acceptable.
2. In some locations, it may be necessary to furnish a coupling which shall be suitable for different materials of pipe. Such couplings to connect steel pipe to cast iron pipes, etc., shall be Dresser Style 62, or approved equal. Coupling rings shall be furnished without pipe stops and gaskets shall be of the plain type. Follower rings shall be designed to adequately confine the gaskets.
3. Flexible couplings on pressure lines shall be suitably harnessed in accordance with the recommendations of the manufacturer, or otherwise protected against a separation from thrust. All joints shall be arranged to prevent rotation of the pipe by a method approved by the OWNER'S Representative.
4. Couplings not shown on the drawings may be installed by the CONTRACTOR to permit non rigid connection to equipment, wall flanges, etc. and as required to facilitate piping installation.

E. Solid Sleeve Couplings

1. Solid sleeve couplings shall be used to connect buried service piping. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.

F. Flexible Couplings

1. Flexible couplings shall be as manufactured by the Red Valve Company and shall consist of a molded reinforced fabric of cotton and natural rubber. Galvanized steel retaining rings shall be furnished. End connections shall match ANSI 125 pound flanges with a minimum pressure rating of 140 psi.

G. Flanged Adaptors

1. The CONTRACTOR shall furnish and install flanged adaptors as specified herein, as a means of inserting new piping and appurtenances into existing piping system.
2. The CONTRACTOR will be responsible for field verification of the outside diameter of all existing pipelines at which the flanged adaptors are to be installed in order that the appropriate flanged adaptors can be provided.
3. Flanged adaptors shall be fabricated from high strength steel and shall have a flange on one end of the body in accordance with ANSI B16.1, Class 150. The

other end of the body shall have a compression end suitable for the use of a wedge gasket and follower. The flanged adaptor shall provide for efficient sealing up 175 psi. All necessary nuts and bolts shall be furnished.

4. Flanged adaptors shall be the product of Dresser Manufacturing Division of Dresser Industries, Inc., Bradford PA, approved equal.

H. Corporation Stops

1. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions shall be used on all corporation stop outlets with connecting piping. Corporation stops shall have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.

I. Valve Boxes

1. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.
2. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal

2.6 FLEXIBLE CONNECTORS:

A. Sleeve Couplings

1. Provide plain end type ends to be joined by sleeve couplings as stipulated in AWWA C219.
   a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.
   b. Outside diameter and out-of-round tolerances shall be within limits specified by coupling manufacturer.
   c. Provide lugs in accordance with ASTM A36.
   d. Provide hardened steel washers in accordance with ASTM A325.
   e. Plastic plugs shall be fitted in coupling to protect bolt holes.
   f. Nuts and bolts:
      1) Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chambered or rounded.
      2) Project ends ¼-inch beyond surface of nuts.
      3) Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.
2. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10-inches long for pipe 30-inches in diameter and larger, and not less than 7-inches long for pipe under 30-inches in diameter.

a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters and other installed equipment.
b. Provide pipe stops in other couplings.

3. Clean and shop prime with manufacturer's standard rust inhibitive primer.
4. Furnish gaskets of a composition suitable for exposure to the fluid service.
5. Where shown on the drawings, anchor sleeve-coupled joints with harness bolts. Weld harness lugs to steel pipe.
6. Where flexible couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported, to prevent transfer of force systems to the equipment. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pipe Erection and Laying

1. Carefully inspect all pipe, fittings, valves, equipment, and accessories prior to installation. Any items which are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings or nameplates with sufficient data for identification to determine their conformance with specified requirements.
2. Exercise all necessary care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item which is not clean. During construction, until system is fully operational, all openings in piping and equipment must be kept closed at all times except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
3. Run pipelines straight and true, parallel to building lines with a minimum use of offsets and couplings. Provide only such offsets as may be required to provide necessary flexibility in pipe lines.
4. Changes in direction of pipelines shall be made only with fittings or pipe bends. Changes in size shall be made only with fittings. Miter fittings, face or flush bushings, or street elbows shall not be used. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
5. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
6. Use of full and double lengths of pipe wherever possible.
7. Unless otherwise indicated, install all supply piping, including shut off valves and strainers, to pumps and other equipment at line size with reduction in size being made only at inlet to control valve or pump. Install supply piping from outlet of control valve at full size to connection of equipment served.
8. All pipe shall be cut to exact measurement and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue

loads, forces or strains on valves, equipment or building elements with piping connections or piping supports.

B. Hangers and Supports

1. The requirements of the applicable sections of ANSI B31 "Pressure Piping" shall be considered as minimum requirements governing fabrication, installation and support of piping systems except where more specific or stringent requirements are stated herein or shown on the drawings.
2. In general, all pipe hangers larger than 10 inches diameter shall be supported from foundations, beams or roofs. Piping smaller than 10 in. may be supported from or on the building slabs. Pipe hangers shall be in accordance with the Standard details and in accordance with those manufactured by Fee & Mason, Manasquan, NJ; ITT Grinnell Corp., Providence, RI; Carpenter & Patterson, Inc., Woburn, MA, or equal.
3. All piping and piping connected equipment, including valves, strainers, traps and other specialties and accessories shall be supported in a manner that will not result in or produce objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or in the building structure either during erection, cleaning, testing or normal operation of the systems. Piping shall not be so restrained, however, as to cause it to shake or buckle between supports or anchors or to prevent proper movement due to expansion and contraction. Piping shall be supported at equipment and valves such that they can be disconnected and removed without further supporting the piping. Piping shall not introduce any strains or distortion to the connected equipment.
4. All concrete inserts for support shall be set in place prior to pouring concrete.
5. All auxiliary structural steel required for the support of piping systems and not shown on the drawings as having been installed as a part of the building structure shall be furnished, installed and prime painted as part of the Work under this section at no additional cost to the OWNER.
6. Hangers and supports shall be installed complete, including lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessory items. All hanger components shall be galvanized. Hangers for horizontal piping shall have adequate means of vertical adjustment for proper alignment of pipe and shall be provided with lock nuts. All hangers and supports in direct contact with copper tubing and PVC shall be copper plated or plastic coated respectively. All hanger components in contact with stainless steel tube or pipe shall be of stainless steel or fiberglass materials.
7. Parallel runs of horizontal pipe 3 in. and under may be supported on trapeze type hangers made up of structural shapes and hanger rods. Otherwise, pipe line shall be supported with individual pipe hangers.
8. It shall be the responsibility of the CONTRACTOR to coordinate the location and method of support of the piping systems with that of all installations under other sections of the specifications. Piping shall be supported in such manner as to impose no eccentric loading on building structural members. The loading of any hanger or support shall in no case exceed the manufacturer's recommended maximum load.

3.2 PIPELINE CLEANING AND TESTING

A. Cleaning

1. All piping including existing piping which is cited to be reused shall be cleaned, flushed, and tested prior to use.
2. All water lines shall be flushed out under full treated water pressure; potable water piping shall be flushed with potable water and drain piping shall be flushed with potable water.
3. Following the blow through, all dirt legs and other low points in lines shall be disassembled and all residual material thoroughly removed. All stop valves shall be removed and cleaned.

B. Testing Preparation
1. The CONTRACTOR shall furnish all equipment and labor necessary to perform the field tests called for in this specification.
2. The CONTRACTOR shall give ample notice to the OWNER'S Representative that tests are to be conducted. The OWNER or his Representative will witness the tests if he wishes.
3. No test shall be performed until all anchors, hangers, supports, test gages, plugs, bulkheads, blanks, etc., are installed. Tests shall be made against bulkheads or where permitted by the ENGINEER.
4. Piping that connects to or is continuous with lines installed by others shall be isolated from such lines by valves or test blanks located at or near the junctions. When necessary to include parts of such lines in the test, the OWNER'S Representative shall be given prior notice so that test conditions may be mutually agreed upon.
5. When piping is required to be painted or insulated, the paint or insulation shall not be applied to the pipe joints until the tests are completed. Underground pipe joints shall be exposed while testing.
6. Safety precautions shall be taken to prevent open ends of piping being in position to cause injury to personnel when blowing out or testing systems.
7. One or more calibrated indicating test gauges shall be connected directly to the piping as necessary to coordinate the pressuring operation. The indicating gauges shall be visible to the operator controlling the pressure. Pressure gauges used shall have dial graduated over a range approximately 2 times the intended maximum test pressure.

C. Testing Methods
1. Testing of pipelines using a compressible fluid such as air shall not be done, unless otherwise noted.
2. Pressure Pipelines - (Other than PVC) Liquid
   a. All pressure pipelines conveying liquids shall be tested by the CONTRACTOR in a manner satisfactory to and witnessed by the OWNER'S Representative.
      1) The section under test shall be filled with water; air expelled from the line and maintained full of water for a period of not less than 24 hours prior to the pressure and leakage test.
      2) The pressure and leakage test shall first consist of raising the water pressure (based on the elevation of the lowest point of the section under test and corrected to the gauge elevation) to a pressure 1.5 times operating pressure or 25 psig, whichever is greater, and maintaining such pressure for a period of 30 min.
      3) The pressure and leakage test shall then consist of dropping the water pressure (based on the elevation of the lowest point of the

section under test and corrected to the gauge elevation) to a pressure of 1.2 times operating pressure or 20 psig, whichever is greater. Such test shall be maintained for an additional 1-1/2 hours during which time the entire section shall be inspected for leaks.

4) For all pipelines not underground the section tested shall be considered as having failed to pass the test if the pressure test cannot be maintained without additional pumping. All visible leaks shall be repaired.

5) If the section fails to pass the pressure and leakage tests, the CONTRACTOR shall do everything necessary to locate, uncover and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the Work. Additional tests and repairs shall be made until the section passes the specified test.

3. Pressure Pipelines - PVC - Liquid

a. The following procedure is required for testing of PVC piping. It shall be performed after all anchors, guides, and supports are installed.

b. Install "air bleeds" in the high point of the system(s) to be tested.

1) Bleeds shall be compatible with piping system and shall become a permanent part of the system.

2) Bleeds shall be used to assure all air is expelled from the system.

c. Blank off all instruments, pumps, tanks, etc. which cannot be subjected to test pressures and procedures without incurring damage.

d. System to be tested shall be isolated for the testing purposes.

e. Provide a written description of piping system to be tested. This shall include:

1) A description of piping system or preferably an isometric of system. It shall describe blanking positions, inlet test position, etc.

2) Date of test.

3) Name of CONTRACTOR'S Responsible Representative(s)

4) Certified Gauge Identification

5) Time test started

6) Completion time of each phase

7) Description of all results

8) Acceptance or rejection of entire test (all phases) by OWNER’S Representative

9) Signature of CONTRACTOR'S Representative(s)

f. Completely fill piping to be tested with water; assure all air is expelled.

g. Static Test Phase

1) Hydraulically pressurize system to 100 psig, using certified gauge installed with block and bleed as pressure reference.

2) NOTE: The time required to pressurize system from 40 psig to 100 psig should be closely observed to assure that the future 2 minute requirement for pressurization in the future cyclic phase can be accomplished with this pressurization equipment.

3) At 100 psig, isolate system and remove pressurization equipment.

4) NOTE: No external means of water addition or pressurization equipment shall remain attached during the test phase.

5) Leave piping pressurized for 4 hours. Observe every joint a minimum of once per hour.

6) Record all observations, especially all abnormalities, weeps, failures, etc.
7) Record the initial pressure and the pressure at each hourly interval.
8) At the successful conclusion of this 4 hour static test phase, rapidly (30 seconds maximum) decrease pressure to 40 psig, using certified gauge as reference, for cyclic phase of test.

h. Cyclic Phase of Test Procedure
1) Proceed with cyclic phase only upon successful static testing phase of test.
2) NOTE: No leaks, failures, weeps, etc. of pipe system acceptable.
3) Connect means of hydraulically pressurizing system.
4) Rapidly fill pipe system within a maximum of 2 minutes to 100 psig using certified gauge as reference.
5) Record start time and finish time of pressurization.
6) Observe system joints during rapid filling.
7) Isolate system when 100 psig pressure is accomplished. Remove pressurization system.
8) Investigate all joints for possible weeps, leaks, etc.
9) Record all observations, especially all abnormalities, weeps, failures, etc.
10) Record final time of cyclic pressure phase.
11) Decrease pressure rapidly to 40 psig (30 seconds maximum).

i. Repeat "Cyclic Phase of Test Procedure" for a total of 5 cycles. Proceed with each cyclic phase only on successful completion (no leaks, etc.) of previous cyclic phase.

j. Upon successful completion of the test, CONTRACTOR shall remove all blanks and return system to the operational mode.

3.3 PIPE AND FITTING SCHEDULE

A. Unless otherwise indicated on the drawings or in the specifications, the following schedule shall apply for piping and fittings:

PIPE AND FITTING SCHEDULE

APPLICATION	PIPE MATERIAL	TYPE OF END CONNECTION
Condensate	304L Stainless Steel or PVC	Flanged Joint
Biogas	316 Stainless Steel	Flanged Joint
Chem Feed/Polymer	Sch 80 PVC	Flanged Joint
Non-Potable/Reuse	DIP/Sch 80 PVC	Flanged Joint
Sludge	DIP	Flanged Joint

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

SECTION 406000 – PROCESS CONTROL & ENTERPRISE MANAGEMENT SYSTEMS INTEGRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. General requirements for the Contractor to incorporate biosolids upgrades into the existing process control management system, producing a fully functioning system to monitor and control the Wastewater Treatment Facility.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American National Standards Institute (ANSI) and International Society of Automation (ISA):
1. ANSI/ISA S5.5 Graphic Symbols for Process Displays.
2. ANSI/ISA-18.2-2016 - Management of Alarm Systems for the Process Industries
3. ANSI/ISA-95.00.02-2010 - Concepts and Rules for Enterprise-Control System Integration
4. ANSI/ISA-99.00.01-2007 - Security for Industrial Automation and Control Systems
5. ANSI/ISA-99.02.01-2009 – Establishing an Industrial Automation and Control Systems Security Program
6. ANSI/ISA-62443-1-1 – Security for Industrial Automation and Control Systems General
7. ANSI/ISA-62443-3-3 – System Security Requirements and Security Levels
8. ANSI/ISA-101.01-2015 – Human-Machine Interfaces for Process Automation Systems

C. Electronic Industries Association (EIA)
1. EIA ANSI/EIA/TIA-568-D (2015) Commercial Building Telecommunications Cabling Standards

D. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE Std 142 (2007) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE Std 8802-3 (2014) Local and Metropolitan Area Network: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

E. National Fire Protection Association (NFPA)
1. NFPA 70 National Electrical Code

1.3 SYSTEM DESCRIPTION

A. The system includes the configuration of a Supervisory Control and Data Acquisition System (SCADA) system per the Biosolids Improvement Project to monitor and control the Wastewater Treatment Facility.

B. It is the Contractor's responsibility to coordinate with all vendors under this contract and to provide all necessary peripheral equipment and software to make this a complete and seamless working system as specified.

C. The Contractor will be responsible for reviewing existing SCADA system architecture and identifying new and existing I/O points, controllers, networks, and interfaces that may be impacted by the new biosolids project. This is crucial for integration and configuration of the plant SCADA system.

D. All balance of plant instrumentation associated with this project shall be incorporated into the plant SCADA system architecture by the Contractor as specified herein. Properly scaled, accurate values of all instrumentation shall be accessed and viewable on the plant SCADA system per direction of the client.

E. All VFCs associated with this project shall be incorporated into the plant SCADA system architecture by the Contractor as specified herein. VFC IO and parameters shall be integrated via hardwired IO signals or Ethernet/IP communications. At a minimum the Contractor shall integrate the following VFC IO parameters for each VFC into the plant DCS:

1. Digital Inputs
   a. Remote/Local status
   b. Fault Status
   c. Running Feedback
2. Digital Outputs
   a. Run Command
3. Analog Inputs
   a. Speed Feedback
4. Analog Outputs
   a. Speed Command

The VFCs shall be fully capable of being controlled and monitored remotely from the plant SCADA system. The Contractor shall program and integrate all necessary logic in the Programmable Logic Controllers, VFCs, and SCADA system to accomplish this. The VFCs shall only be capable of being controlled remotely when the designated door-mounted operator switch is in the "remote" position. When operated under remote control, the VFCs shall adhere to the following: in the event of a disruption in the communication link between the VFC and the SCADA system or a failure in the IO (Input/Output) signal, the VFC shall automatically cease operation. This fail-safe mechanism is designed to mitigate any potential risks or damages that could arise from unmonitored operation, ensuring the plant maintains high standards of safety and reliability.

1.4 SOFTWARE

A. The Contractor is expected to contain all necessary SCADA and PLC software licensing needed to complete SCADA integration tasks. This includes but is not limited to SCADA development software, SCADA operating software, and programmable logic controller licensing. It is the Contractor's responsibility to determine proper licensing needed to integrate the SCADA upgrade into the existing system. Controller licensing will be needed to communicate and configure data points to the SCADA system. Currently, existing SCADA computers are running Allen-Bradley FactoryTalk Site Edition (Local Station) version 12.00.00 (CPR 9 SR 12).

B. The software shall provide the communication, programming, and control capabilities necessary to support all specified points and functions. The SCADA system shall be online at all times and shall perform all required functions as specified.

1.5 HARDWARE

A. Three existing SCADA workstation computers will need modified in order to integrate the Biosolids Improvement Project upgrade processes. It is the Contractor's responsibility to configure each computer, modifying and customizing software to ensure seamless monitoring and control of the Wastewater Treatment Facility.

1.6 The SCADA system shall be used to monitor and control the operation of process equipment. It shall provide for operator interaction, overall control, system supervision, process equipment control, and monitoring.

A. Screens
   1. The Contractor shall utilize existing screens, P&ID's and project drawings for the basis for modeling the SCADA system.
   2. System graphics displays shall be hierarchical displays which integrate dynamic data into the display. System graphics shall reflect actual system configuration.
   3. Each system schematic shall be included as a separate display. Different colors, textures, and use of inverted video shall be used for various components and dynamic data.
   4. The displays shall include standard and/or custom symbols. A library of callable display symbols containing symbols for all necessary equipment and control devices shall be furnished. Symbols shall conform to ANSI/ISA S5.5 where applicable.
   5. Data associated with a display shall be updated within 5 seconds of the digital status change or the analog change more than the analog change differential.
   6. Any dynamic data which is not current, due to communications failure, or point out of service, shall be highlighted or flagged.

B. At a minimum, the Contractor shall provide the following:
   1. Process Overview
      a. Show plant overview with new equipment such as Blowers, Mixers, Pumps, Tanks and General Equipment. Depict running statuses, process data values, and animations to match the existing system.

2. In addition to the Process Overview Screen, equipment statuses and setpoints shall be available for all newly installed equipment and instrumentation. The following information indicated is a minimum requirement, refer to the drawing package and Owner direction for all points:
   a. Dewatering Building:
      1) Pump Run Statuses
      2) Pump Speed
      3) Pump Run Times
      4) Equipment HOA Indication
      5) Equipment On/Off Setpoints
      6) Alarms/Failures
      7) Level, Temperature, and Pressure Indication
      8) Flow Rates
      9) Valve Feedback Indication
3. Command Software
   a. The software shall provide for defining and selecting points, parameters, graphics, report generation, and all other functions associated with operation. The operator commands shall be usable from keyboards with individual operator passwords as specified.
   b. Command Input
      1) Command menus shall utilize full words and acronyms selected to allow operators to use the system without extensive training or a data processing background. The system shall prompt the operator.
   c. Command Input Errors
      1) The system shall supervise operator inputs to ensure they are correct for proper execution. Operator input assistance shall be provided whenever a command cannot be executed because of operator input errors.
4. Trending Screen
   a. Show Active as well as Historical data for all analog points. Log new analog points as historical data as required.
   b. Additional pens representing multiple parameters shall be added to the trend screen via new process variables using the same configuration as existing pens.

5. Report Screens
   a. A report is to be automatically generated each month or when selected with new and existing data from upgrade as directed by Owner.
6. Alarms
   a. Alarm Overview
      1) All new alarms shall be integrated into existing alarm database.
      2) Alarm data displayed and stored shall include identification of the alarm, date and time to the nearest second of occurrence, device or sensor type, limit exceeded (if analog), engineering units, current value or status, alarm class, and alarm messages.
      3) Required setpoints for each alarm shall be coordinated with Owner, equipment specifications and as noted in the drawings package.

4) Alarms shall be integrated into the existing alarm notification software suite per Owner demand. All added alarms are to be imitated on the SCADA system to verify proper functionality, and any alarms added to the existing alarm notification suite shall be imitated to ensure plant personnel of interest receive desired remote alarm notifications.

b. Digital Alarms
   1) Digital alarms shall be subject to immediate reporting, within the alarm response time.

c. Analog Alarms
   1) These alarms shall be subject to immediate reporting, within the alarm response time. The analog readings shall be compared to predefined high and low limits and alarmed each time a value enters or returns from a limit condition. The program shall automatically change the high or low limits, or both, based on time scheduled operations as specified, allowing for a time interval before the new alarm limit becomes effective.
   2) For those applications where setpoint adjustments are made, the alarm limit shall be keyed to a finite deviation traveling with the setpoint.
   3) All new signals shall be scaled properly so that plant personnel can view accurate readings on the SCADA system.

d. Alarm Messages
   1) A unique message with a field of 60 characters shall be provided for each alarm. Assignment of messages to a point shall be capable of being editing by an operator. Secondary messages shall be assignable by the operator for printing to provide further information, such as telephone lists or maintenance functions, and shall be editable by the operator.

e. Alarm Monitoring
   1) The system shall measure, transmit, and display analog values, including calculated analog points. Differential measurements shall be displayed as positive or negative values with respect to their reference points shown. An analog change in value is defined as a change exceeding a preset differential value as specified. Each analog change in value shall be operator selectable and settable to provide for a minimum reporting change in value of one-half the specified end-to-end accuracy of the measured variable. Displays and reports shall express analog values in proper engineering units with sign.

7. Tag Attributes
   a. Each new tag shall have an instrumentation tag name of less than 10 characters. The name shall be alphanumeric. All other application programs shall use this tag name as their sole reference to the data element assigned.
   b. For tags assigned to actual hardware points, the block shall also contain fields for the following:
      1) Hardware Device Name
      2) Hardware address
      3) Hardware specific parameters

4) Signal conditioning requirements
   (a) Each tag associated with a hardware address or capable of causing an alarm condition shall have a means of displaying a descriptive message on the alarm banner. The descriptor shall be at least 40 characters in length.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Verification of Conditions. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Discrepancies. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

2.2 SOFTWARE INTEGRATION

A. Integrate/program software, as indicated, with manufacturer's written instructions, and with recognized industry practices.

B. The Contractor shall load software required for an operational control system, including databases (for points specified and shown), operational parameters, and system, command, and application programs. The Contractor shall adjust, tune, debug, and commission all software and parameters for controlled systems to assure proper operation in accordance with the sequences of operation and database table.

2.3 FIELD QUALITY CONTROL

A. Verify all field instruments and devices are properly communicating with the system.

B. Confirm all analog signals like tank levels, flow rates, pH, etc. are being accurately monitored by SCADA and have correct scaling. Calibrate instruments if needed.

C. Ensure all discrete or digital signals i.e. pump status, valve open/closed are being reliably captured by the SCADA system.

D. Validate safety critical alarms and interlocks are functioning properly.

E. Perform failover and redundancy checks to ensure integrity of upgraded system.

F. Ensure trends are logging and updating correct field data at the desired rate.

G. Verify operators are able to acknowledge and manage existing and new alarms properly.

2.4 POINT DATA FIELDS

A. I/O point data fields will be subject to review and modification by the Engineer. The Contractor and the Engineer shall review, complete, and verify this information during implementation. The Owner will assist with this task by obtaining or advising preference for ranges and engineering units.

2.5 SUBMITTALS

A. Submit in accordance with contract requirements:
   1. Letter indicating compliance with the Bid Package with any exceptions documented and submitted with the bid.
   2. Color prints of SCADA screens on 8 1/2 x 11-inch paper.
   3. SCADA Database on 8 1/2 x 11-inch paper
   4. Scripts developed for the screen displays
   5. Diagram showing how screens are linked together

B. System Description:
   1. System description, indicating how equipment will operate as a system to meet the performance requirements of the SCADA System.

C. O&M Manuals:
   1. Prepare two (2) copies of operating and maintenance manuals in hard cover binders and one electronic copy in an electronic PDF format. At a minimum the binders and electronic copy shall include:
      a. System control narrative description of operation
      b. Safe system operation information
      c. Copies of all start-up procedure measurements.
      d. Copies of all testing data and reports.
      e. Contact information for technical assistance
      f. Warranty Information
      g. Contact information for warranty issues

2.6 TRAINING

A. Comprehensive operator training will be provided for the plant SCADA software to equip the operators with the necessary knowledge and skills for utilizing the upgraded plant SCADA system.
   1. Operators will learn to effectively control and monitor the plant processes using the upgraded SCADA software.
   2. Training content provided will be clear, concise, and easily understandable by operators with varying levels of technical expertise.

2.7 WARRANTY

A. All components supplied and installed by the Contractor shall be warranted against defects in material and workmanship for a period of at least 12 months, commencing upon the date of acceptance by the Owner. Warranty service shall be provided by a qualified factory-trained service representative. The warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

2.8 DEMONSTRATION

A. When all required tests have been performed and prior to final approval, a qualified representative of the supplier shall thoroughly demonstrate the operation of all items installed under this section to the Owner's personnel.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

SECTION 406343 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 406716 – Programmable Logic Controllers

C. General Requirements for Process Equipment – Section 460500

1.2 DESCRIPTION OF WORK

A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install programmable logic controller (PLC) equipment and Human Machine Interface (HMI) equipment, including programming, software, licenses, and other related components as part of manufacturer-supplied control panels ready for integration in the Plant SCADA network.

B. The Contractor will integrate all data to and from the control panel to the existing Plant SCADA system. The Contractor is responsible for ensuring all terminations are functional, and that data is transmitted to the SCADA system. The Contractor shall ensure that the integrated systems meet the requirements and objectives of the project.

1.3 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. Control panels detailing interconnecting wiring, terminations, ratings, etc.

C. Source Quality Control Submittals: Results of required control panel shop tests.

D. Site Quality Control Submittals: Written report giving the results of the required field tests and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

E. All programming software, licenses, cables, hardware, and software keys, and documented programs to be licensed in the owner's name and turned over to the owner after start-up and checkout completion. Programs to include all updates required during the panel’s start-up and commissioning.

F. HMI screens – Draft screens for review and comment by Engineer.

G. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

1.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all components called for under this Section shall be supplied by a single manufacturer.

1.5 WARRANTY

A. Provide manufacturer's standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Allen-Bradley by Rockwell Automation

2.2 GENERAL CRITERIA

A. If a vendor-supplied control panel is to be provided with a Programmable Logic Controller (PLC), the PLC shall comply with the following specification requirements, unless noted otherwise.

2.3 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. The control panel will be based around the Allen-Bradley Logix Platform as detailed below:
   1. ControlLogix:
      a. Each PLC will be capable of communicating to all the other PLCs through Ethernet.
      b. The controller rack will be equipped the following features at a minimum:

PART NUMBER	DESCRIPTION
1756-L55M14	3.5Mbyte Processor
1756-ENET	Ethernet Bridge Module
1756-IB16	16 Point 10-30VDC Input Card
1756-OB16	16 Point 10-30VDC Output Module
1756-IF8	8 Point Analog Input Card
1756-OF8	8 Point Analog Output Card
1756-PA75	Power Supply
1756-A7	Seven Slot Chassis

c. The panel will be sized for 20% spare I/O Count. The spare I/O is to be calculated based on each type of installed I/O card (e.g. 25 Digital Inputs are required and utilized, and two 16-point cards were provided. Seven (7) remaining available digital points divided by 32 equals 21.9% spare and thus meets the requirement for Digital Inputs). In addition, all spare I/O points are to be wired to terminal blocks complete with interposing relays and signal isolators as required to the field terminal blocks.

d. The panel will have 3 spare slots for insertion of future modules.

2. CompactLogix:

a. Each PLC will be capable of communicating to all the other PLCs through Ethernet.

b. The controller rack will be equipped the following features at a minimum:

PART NUMBER	DESCRIPTION
1769- L33x	2Mbyte Processor
1769-IQ16	16 Point 10-30VDC Input Module
1769-OB16	16 Point 10-30VDC Output Module
1769-IF4	4 Point Analog Input Card
1756-OF2	2 Point Analog Output Card
1769-PA4	Power Supply

c. The panel will be sized for 20% spare I/O Count. The spare I/O is to be calculated based on each type of installed I/O card (e.g. 25 Digital Inputs are required and utilized, and two 16-point cards were provided. Seven (7) remaining available digital points divided by 32 equals 21.9% spare and thus meets the requirement for Digital Inputs). In addition, all spare I/O points are to be wired to terminal blocks complete with interposing relays and signal isolators as required to the field terminal blocks.

d. The panel will have 3 spare slots for insertion of future modules.

3. MicroLogix:

a. Each PLC will be capable of communicating to all the other PLCs through Ethernet.

b. The panel will be sized for 20% spare I/O Count. The spare I/O is to be calculated based on each type of installed I/O card (e.g., 25 Digital Inputs are required and utilized, and two 16-point cards were provided. Seven (7) remaining available digital points divided by 32 equals 21.9% spare and thus meets the requirement for Digital Inputs). In addition, all spare I/O points are to be wired to terminal blocks complete with interposing relays and signal isolators as required to the field terminal blocks.

c. The panel will have 3 spare slots for insertion of future modules.

2.4 HUMAN MACHINE INTERFACE (HMI)

A. All HMI's will be of the PanelView Plus Series by Allen-Bradley. Each HMI must be capable of the following:

1. Communicating directly over Ethernet.
2. The display must be in color.
3. Minimum size of display to be 10 inches.

4. The programming for each operator interface unit will be provided to the Owner on a USB drive or other approved media upon completion of the warranty period.

B. See Paragraph 2.5 PLC PROGRAMMING for programming requirements that may impact the Operator Interface Programming.

2.5 PLC PROGRAMMING

A. All programs must be properly documented so as to allow plant personnel to troubleshoot or append the program.

B. All programs will be in Ladder Logic and/or Function block format. Structured text or similar programming is not acceptable.

C. Upon the completion of the vendors' warranty period, a finished copy of the program will be transferred to the Owner.

D. The entire plant can be fully controlled through the existing SCADA system. The panel shall be configured so that only the SCADA system needs to be modified. Accordingly, the control panel manufacturer needs to provide the following:

1. All programs will be written as if control from SCADA is possible at time of start-up. This will eliminate the need for the VOCP suppliers to re-write their program for full SCADA control.
2. All interface addresses will be grouped into databases for communication to and from the SCADA. These databases will have the following organization:
    a. Integers
        1) There will be two Integer databases. One for data coming from the SCADA (Write) and another for data going to the SCADA (Read).
            a) The Read database will also contain all data to be displayed at the SCADA that is not required for full control. An example is Motor Running Status.
            b) All read and write bit data will be compacted into integer words for ease of data transfer. For example, N100 may be chosen as the Read file. Furthermore, Motor 1 Running might be N100:0/0 and Motor 2 Running might be N100:0/1.
        2) There will be two Floating Point databases. One for data coming from the SCADA (Write), and another for data going to the SCADA (Read).
            a) The Read database will also contain all data to be displayed at the SCADA that is not required for full control. An example is Motor Run Time.
3. The panel manufacturer will provide the Owner with a complete listing of all points in each database and what those points do. A sample table is shown below. These data tables will be sent to the Owner six (6) weeks after the panel submittal has been completed.
4. If the data table changes, a complete copy will be given to the Owner.

ADDRESS	DESCRIPTION	LOW EQUALS	HIGH EQUALS	RANGE
READ WORDS				
N100:0/0	Motor #1 Running	Off	On	
N100:0/1	Motor #2 Running	Off	On	
N100:0/2	Motor #1 Fail	Normal	Failed	
N100:0/3	Motor #2 Fail	Normal	Failed	
N100:1	System Status Word			0=Normal 1=Manual 2=Off 3=System Fault 4=Gen Power

ADDRESS	DESCRIPTION	LOW EQUALS	HIGH EQUALS	RANGE
WRITE WORDS				
N101:0/0	Motor #1 SCADA manual mode	Auto	Manual	
N101:0/1	Motor #1 On/Off when in SCADA Manual Mode	Off	On	
N101:0/1	Motor #2 SCADA manual mode	Auto	Manual	
N101:0/2	Motor #2 On/Off when in SCADA Manual Mode	Off	On	
READ FLOAT				
F102:0	Motor #1 Elapsed Time			Tenths of an hour
F102:1	Motor #2 Elapsed Time			Tenths of an hour
F102:2	Well Level			0-5.00 Feet
WRITE FLOAT				
F103:0	Desired Level Set point			0-5.00 Feet

PART 3 - EXECUTION

3.1 INSTALLATION

A. All components must be installed within the control panel enclosure in a controlled environment in the panel factory in accordance with manufacturer's instructions and approved drawings.

B. All installation of the control panels shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

3.2 SOURCE QUALITY CONTROL

A. If required for a Manufacturer-supplied control panel, a complete factory test of the entire control system prior to its shipment to the job site performed by Manufacturer, Owner, and Engineer at the manufacturer's facility. Written approval for shipment following acceptance of the factory test by Engineer.

B. System manufacturer using simulated inputs to assure all inputs, outputs, and application software are functioning according to the intent of the plans and specifications is the primary test objective. Simulated system faults and failures are also testing objectives.

C. Demonstrate all functions of the system.

D. Provide at least a two-week written notification to the Engineer prior to the start of the witnessed factory test.

3.3 FIELD QUALITY CONTROL

A. Site Tests

1. Calibrate all transmitters and receivers to imposed input values representing 10%, 50% and 80% of full scale. Verify the zero and span calibration of all transmitters. Where totalizers are part of the flow measuring system, calibrate at least three (3) points of imposed inputs covering the range of the units. Use differential heads developed by manometers as inputs in the case of flow meters, measured level or pressure in other cases. Adjust the receiving devices to read the calibrated output of the initial calibration. After placing each measuring system in service, connect a manometer to the test connections provided in the piping and make an actual comparison of the measured variable to readout. Each system must meet the accuracy indicated in the Specifications.
2. Adjust secondary functions, such as alarm actuation and pacing, during initial calibration and demonstrate proper calibration after the system is placed in service. Seal linkage or range adjustments by colored lacquer in the presence of the Engineer immediately following calibration.
3. Conduct process calibration, such as volumetric draw down tests to check flow measurement and totalization and level measurements, on all measuring systems

as requested by the Engineer. Provide the necessary gauges and assistance in making these tests.

4. Test all control systems, operation of all level transmitters and probes, solenoid valves and automated valves in all modes of operation and demonstrate successful performance.
5. Provide field service representative of the distributed logic control equipment manufacturer to verify that instruments have been properly installed, configured, and meet the manufacturer's qualifications for warranty.

3.4 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

SECTION 406716 – PROCESS CONTROL PANELS & HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 406343 – Programmable Logic Controllers

C. General Requirements for Process Equipment – Section 460500

1.2 DESCRIPTION OF WORK

A. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install manufacturer-supplied control panels, including programming, software, licenses, and other related components, ready for integration into the Plant SCADA network.

B. The Contractor will integrate all data to and from the control panel to the existing Plant SCADA system. The Contractor is responsible to ensure all terminations are functional and data is transmitted to the SCADA system. The Contractor shall ensure that the integrated systems meet the requirements and objectives of the project.

1.3 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. Control panels detailing interconnecting wiring, terminations, ratings, etc.

C. Source Quality Control Submittals: Results of required control panel shop tests.

D. Site Quality Control Submittals: Written report giving the results of the required field tests and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

E. All programming software, licenses, cables, hardware, and software keys, and documented programs to be licensed in the owner's name and turned over to the owner after start-up and checkout completion. Programs to include all updates required during the panel’s start-up and commissioning.

F. Control Narrative: Functional control narrative/philosophy for equipment supplied as well as ancillary equipment.

G. Input/Output (I/O) List, including tag names and scale range

H. Human Machine Interface (HMI) screens – Draft screens for review and comment by Engineer.

I. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

1.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all similar components called for under this Section shall be supplied by a single manufacturer.

B. Equipment Manufacturer Qualifications: The equipment shall be the standard products of a manufacturer who has been regularly engaged in the successful production of high-quality equipment and systems of the type specified for at least 10 years, has supplied such equipment for at least five years of the ten-year period, and has at least three installations in successful operation for at least five years.

C. Examination of Equipment for Safety: Equipment and materials installed within control cabinets shall be U.L. Listed, Labeled or identified.
1. Equipment and materials shall have been tested by a testing laboratory; and shall meet, or exceed, nationally recognized standards, or have been found suitable for use in the specific manner as intended by the Engineer.
2. Equipment and materials utilized shall be included within published listings prepared by testing laboratories, inspection agencies or other organizations concerned with product evaluations.

1.5 WARRANTY

A. Provide manufacturer’s standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 CONTROL ENCLOSURES

A. Enclosures for all systems and sub-systems shall be provided in accordance with the following. The final selection of the NEMA rating should be determined based on the specific environmental conditions and requirements of the installation site. Consultation with the systems integrator and equipment supplier will be necessary to confirm the appropriate NEMA rating.

B. All components of the control panel, including but not limited to the PLC, Operator Interface, and additional hardware, must be suitable for operation within the selected NEMA-rated enclosure. Ensure all components meet the same NEMA requirements as the enclosure itself.

C. Construction:

1. NEMA 12 Enclosures: NEMA 12 enclosures shall be for indoor use only and shall provide a degree of protection against dust, dirt dripping water and external condensation of non-corrosive liquids.
   a. Control enclosures shall be constructed of 14-gauge steel minimum, with continuously welded seams. All seams shall be ground smooth.
   b. Body stiffeners shall be added where required to prevent the enclosures from sagging or bowing.
   c. Enclosures shall have piano type hinged doors with neoprene gaskets.
   d. Enclosure doors shall be held closed by a 3-point roller latching mechanism operated by an oil-tight key-locking handle.
   e. A minimum of two removable lifting eyes shall be attached to the top of floor mounted enclosures.
   f. Print pocket shall be attached to one door of each enclosure.
   g. Mounting plates/panels shall be of one-piece construction 14 gauge steel minimum. The panel shall cover most of the rear of the enclosure. Where required, panels shall be mounted on the sides of the enclosures for additional mounting space.
   h. Manufacturers:
      1) Hoffman Engineering Company or equal.
2. NEMA 4 Enclosures Stainless Steel: NEMA 4 enclosures shall be for indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water:
   a. Control enclosures shall be constructed of 14 gauge minimum 304 stainless steel with continuously welded seams. All seams shall be ground smooth.
   b. Body stiffeners shall be added where required to prevent the enclosure from sagging or bowing.
   c. Enclosures shall have 304 SS piano type hinged doors with neoprene gaskets.
   d. Enclosure doors shall be held closed by 304 SS screws and clamps on three sides of door.
   e. A minimum of two removable lifting eyes shall be attached to the top of floor mounted enclosures.
   f. Print pocket shall be attached to one door of each enclosure.
   g. Mounting plates/panels shall be of one-piece construction 14 gauge steel minimum. The panel shall cover most of the rear of the enclosure. Where required, panels shall be mounted on the sides of the enclosures for additional mounting space.
   h. Manufacturers:
      1) Hoffman Engineering Company or equal.
3. NEMA 4X Enclosures: NEMA 4X enclosures shall be for indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water, with additional resistance to corrosion, suitable for environments with the presence of corrosive materials.
   a. Control enclosures shall be constructed of 14 gauge minimum 304 stainless steel with continuously welded seams. All seams shall be ground smooth.

b. Body stiffeners shall be added where required to prevent the enclosure from sagging or bowing.
c. Enclosures shall have 304 SS piano type hinged doors with neoprene gaskets.
d. Enclosure doors shall be held closed by 304 SS screws and clamps on three sides of door.
e. A minimum of two removable lifting eyes shall be attached to the top of floor mounted enclosures.
f. Print pocket shall be attached to one door of each enclosure.
g. Mounting plates/panels shall be of one-piece construction 14 gauge steel minimum. The panel shall cover most of the rear of the enclosure. Where required, panels shall be mounted on the sides of the enclosures for additional mounting space.
h. Manufacturers:
1) Hoffman Engineering Company or equal.

4. Identification i.e., nameplates, legend plates, and tags: All nameplates, legend plates, labels and tags shall conform to ISA Recommended Practice publication ISA-RP60.6.
a. Nameplates: Nameplates shall be used to display basic information including function.
1) Letters shall be gothic upper case (capital letters); minimum height shall be ⅛ inch with a 3/64-inch space between lines.
2) The characters shall be engraved using an industry standard engraving machine. Nameplates shall be attached to the enclosure using double-faced pressure-sensitive tape. Where the environment is not conducive to tape i.e., outdoors, NEMA 4, 4X, and 3R environments stainless steel screws shall be used in place of the tape.
3) Enclosure identification nameplates shall be larger sized letters, 3/16 inch minimum.
4) Abbreviations shall conform to appendix B of ISA Recommended Practice publication ISA-RP60.6.
5) Margins shall conform to the following:
a) With holes
i. Top/bottom - 1/16" min
ii. Sides left/right - 5/16" min
b) Without holes
i. Top/bottom - 1/16" min
ii. Sides left/right - ⅛” min

5. Legend Plates: Legend plates shall be used to display basic functions of push buttons, selector switches and pilot lights.
a. Letters shall be gothic upper case (capital letters); minimum height shall be ⅛ inch with a 3/64-inch space between lines.
b. Legend plates shall be made of laminated engraving stock having a black core with a white surface.
c. The characters shall be engraved using an industry standard engraving machine.
d. Legend plates shall be held to the enclosure by the ring nuts used to hold

the operator in place.

e. All legend plates for a particular panel shall be of the same size and shape.

f. Standard Selector Switch legends shall include:
   1) Hand/Off/Auto
   2) Local/Remote
   3) Off/On

g. Standard Push Button legends shall include:
   1) Start
   2) Stop
   3) Stop Lockout
   4) Low
   5) High
   6) Reset

h. Wire Markers: Each wire shall be identified on both ends of the wire with wraparound of shrink type wire markers. The wire marker number shall be a unique number, incorporates the instrument/equipment tag number if applicable, shall be easily cross referenced with schematic drawings, and shall have the same number on both sides of the wire.

i. Adhesive Labels: Adhesive labels shall be used inside the panel to identify equipment. The labels shall be smudge proof and shall have an adhesive back. The printing on the labels shall be done by mechanical means only.

6. Wiring: All wiring shall conform to National Electric Code's latest revision Article 310 - "Conductors for General Wiring," table 310-17. All wire shall be copper.

   a. Control wiring shall be 16-gauge, 600-volt, type THHN/MTW. Power wiring shall be 600-volt type THHN/MTW sized as required.

   b. All analog signal wiring shall be 16 gauge twisted pairs with foil shield and drain wire. The insulation shall be 600-volt, 90˚C. Drain wires shall be grounded at the panel only.

   c. All wiring shall conform to the following color code:
      1) 120 VAC power wires 1 phase i.e. lights, heaters - Black hot and white neutral.
      2) 120 VAC control wires – red.
      3) 120 VAC externally powered – yellow.
      4) 24 VDC – Blue.
      5) Ground – Green.

   d. To avoid inductive pickup power wiring or control wiring shall have a maximum possible separation from signal wiring. A practical distance is not less than 6 in. If power wiring has to cross the signal wiring, the crossing should be as close to a right angle as possible.

   e. Wires shall be run in open slot vinyl wire duct with covers. Wireduct shall be held to the back plate with nylon "push" type rivets filled no more than 75%. Where it is not practical to use wireduct, wire ties shall be used to bundle the wires together in a neat and professional manor. Manufacturer: Panduit.

   f. Where wire is required to flex often (i.e., around door hinges) high strand wire and spiral wrap shall be used.

   g. All spare PLC I/O points shall be run to terminal blocks. All spare I/O points (20%) are to be wired to terminal blocks complete with interposing relays and signal isolators as required to the field terminal blocks. The wiring is to be complete such that future I/O points require a field termination only to complete the connection to the PLC.

h. Control panels shall have a well-designed disconnecting means that extends through the panel front cover. This disconnect will shut off a main circuit breaker inside the control panel and be lockable in the off position with a standard padlock. Wires that are not de-energized by the main breaker shall be of the same color and labeled with a warning label stating same.

i. Control voltages shall not exceed 120 VAC. Control transformers shall be sized one size larger than the computed load and be protected by properly sized fuses or circuit breakers on the primary and secondary sides.

j. Control power and neutral shall not be jumped from device to device. Power distribution blocks shall be used. Manufacturer: Square D class 9080 or approved equal.

7. Grounding: Two ¼" x 1" copper ground buses shall be supplied with each enclosure. One ground bus shall be electrically bonded to the panel and shall be used to ground all equipment. The other ground bus shall be an isolated ground bus and shall be use to ground the drain wire of signal wiring. No more than 5 drain wires shall be jumpered together before being run to the isolated ground bus. The isolated ground bus shall be connected to the non-isolated grounded bus with one piece of 10-gauge wire.

8. Painting: Interior and exterior surfaces of all enclosures shall be thoroughly cleaned and painted with rust-inhibitive primer. The interior and mounting plates shall be painted white with a polyurethane enamel. All pits and blemishes in the exterior surface shall be filled. Exterior surface shall be smooth and painted with two coats to a film thickness of 4 mils. Paint color for carbon steel enclosures shall be ANSI 61 Gray, polyurethane enamel. One pint of finish color paint shall be furnished with the panels to repair future scratches. Stainless Steel enclosures shall not be painted but shall have a brushed finish.

9. Cabinet Lighting:
   a. Provide fluorescent lighting kits for all floor mounted control enclosures.
   b. Lighting kits shall use 115 VAC, 60 hz.
   c. Lighting kits shall use remote mounted door activated switch.
   d. 2-foot fluorescent bulb with terminal block for electrical connections.
   e. Rigid metal construction with heavy duty mounting bracket and lens protector for bulb.
   f. Manufacturers: Hoffman Engineering or approved equal.

10. Climate Control:
    a. Use the following as environmental conditions depending on the location of the control panel:
       1) Computer Room, Air Conditioned - Normal Temperature: 60-80F; Normal Humidity: 40-60%, NEC Class: Non-Hazardous.
       2) Inside, Air Conditioning - Normal Temperature: 60-80F; Normal Humidity: 10% (winter) -70% (summer); Upset Temperature (Up to 4 hr HVAC system interruption): 40-105F; Upset Humidity: 10-100%; NEC Class: Non-Hazardous.
       3) Inside - Normal Temperature: 20-104F; Normal Humidity: 10-100%; NEC Class: Non-Hazardous.
       4) Inside, Corrosive - Normal Temperature: 20-104F; Normal Humidity: 10-100%; Corrosive Environment: Hydrogen Sulfide Gas, Sea Air, Chlorine Gas; NEC Class: Non-Hazardous.
       5) Inside, Hazardous - Normal Temperature: 20-104F; Normal

Humidity: 10-100%; NEC Class: Class 1, Division 1, Group D.

6) Outside - Normal Temperature: Minus 20-104F; Normal Humidity: 10-100%; Environment: rain, snow, freezing rain; NEC Class: Non-Hazardous.

7) Outside, Corrosive - Normal Temperature: Minus 20-104F; Normal Humidity: 0-100%; Corrosive Environment: Hydrogen Sulfide Gas, Sea Air, Chlorine Gas; NEC Class: Non-Hazardous.

8) Outside, Hazardous - Normal Temperature: Minus 20-104F; Normal Humidity: 0-100%; Environment: rain, snow, freezing rain; NEC Class: Class 1, Division 1, Group D.

b. Climate control unit shall be a complete unit with thermostat, heater, and fan integrated into the same housing. The unit shall be a thermostatically controlled fan-driven heater unit.

c. Control panel enclosure shall have a low-point cold air intake vent and a high-point heated air discharge vent. The heater unit shall be mounted near the cold air intake vent. The heater unit shall draw cold air from the cold air intake vent and discharge the heated air from the top of the heater unit. The heated air rises and flows through the hot-air discharge vent.

d. Heater supply voltage shall be 115 VAC, 60 hz. The heater unit shall have a terminal block for electrical connections.

11. Ground Fault Interrupt Receptacle: Supply one (1) 15 Amp Duplex receptacle in the inside of the enclosure for all control panels that may require programming with a lap top computer or handheld programmer that may require 115 VAC supply.

2.2 CIRCUIT BREAKERS

A. Construction:

1. Circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified.

B. Spare parts:

1. (Not Used).

C Manufacturers:

1. Square D model QOU.
2. Allen Bradley.
3. Westinghouse.
4. Approved equal.

2.3 SELECTOR SWITCHES

A. Construction:

1. Selector switches shall be 30.5 mm, heavy duty, non-illuminated. Switches shall have double-break silver contacts. Provide maintained contacts unless otherwise indicated on the Drawings. Provide auxiliary contact blocks where indicated on the Drawings or in the Description of Operation. Provide legend plates for each switch.

B. Spare Parts:
1. (Not Used)

C. Manufacturers:
1. Square D Type K (NEMA 12), Type SK (NEMA 4).
2. Allen Bradley.
3. Cutler Hammer.
4. Approved equal.

2.4 PUSH BUTTONS

A. Construction:
1. Push buttons shall be black, 30.5 mm, heavy duty, corrosion resistant, non-illuminated type with replaceable contact blocks. Provide double-break silver contacts. "Stop" push buttons shall have extended heads. Stop Lockout Stations shall have a locking attachment that will allow the operator to lock the stop button in the depressed position using a standard padlock with a 5/16 inch shackle. Provide legend plates for each push button.

B. Spare Parts:
1. (Not Used)

C. Manufacturers:
1. Square D Type K (NEMA 12), Type SK (NEMA 4).
2. Allen Bradley.
3. Cutler Hammer.
4. Approved equal.

2.5 PILOT LIGHTS

A. Construction:
1. Pilot lights shall be NEMA 4X, 30.5 mm, heavy duty, corrosion resistant, push-to-test, transformer type with LED bulbs. Voltage rating shall be 120 volts AC. Provide colored lens; red for "off" or "closed", green for "on" or "open", amber for "fault" or motor on low speed (two speed motors), blue for "status" and white for "indication" unless otherwise noted on Drawings. Provide legend plates for each pilot light.

B. Spare Parts:
1. Provide one spare lens of each color.
2. Provide 10% spare bulbs.

C. Manufacturers:
1. Square D Type K (NEMA 12), Type SK (NEMA 4).
2. Allen Bradley.
3. Cutler Hammer.
4. Approved equal.

2.6 FUSES

A. Construction:
1. All fuses shall be sized per NEC Code.

B. Spare Parts:
1. Provide 10% spare fuses.

C. Manufacturers:
1. Bussman
2. Allen Bradley.
3. Littlefuse
4. Approved equal.

2.7 ALARM HORNS

A. Construction:
1. Alarm horns shall be flush mounted as indicated on the Drawings. Voltage rating shall be 120 VAC. Provide adjustable three-to-five-minute timer to silence the horn automatically.

B. Spare Parts:
1. (Not Used)

C. Manufacturers:
1. Federal Signal Model 350
2. Approved equal.

2.8 TERMINAL BLOCKS

A. Construction:
1. Terminal blocks shall be provided in each control enclosure. All terminal blocks shall be rated for 600 volts AC and shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring drawings.
2. All field wiring shall be terminated on terminal blocks prior to further connection within the panel.
3. All spare I/O points (20%) are to be wired to terminal blocks complete with interposing relays and signal isolators as required to the field terminal blocks. The wiring is to be complete such that future I/O points require a field termination only to complete the connection to the PLC.

B. Spare Parts:
1. Provide 20% spare terminal blocks in each control panel.

C. Manufacturers:
1. Phoenix Type UK4
2. Allen Bradley.
3. Weidmuler

4. Approved equal.

2.9 24-VOLT DC POWER SUPPLIES

A. Construction:
1. Provide DC power supplies as required to power instruments requiring external power. Power supplies shall convert 120 VAC, 60 hertz power to DC power. Output, overvoltage, and overcurrent protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

B. Spare Parts:
1. Provide one spare power supply equal to the current rating of the largest power supply provided.

C. Manufacturers:
1. Power One.
2. Acopian.
3. Approved equal.

2.10 GENERAL PURPOSE RELAYS

A. Construction:
1. Relays shall be designed for multiple switching applications at 24 volts. Standard contact arrangement shall be DPDT with pilot light. Relays shall plug into an 8 or 11 pin octal single tier screw terminal socket.

B. Spare Parts:
1. Provide ten percent (10%), but not less than two (2) of each type.

C. Manufacturers:
1. Square D class 8501 (2 & 3 pole); Square D Telemecanique (> 3 poles).
2. Approved equal.

2.11 SIGNAL ISOLATORS

A. Construction:
1. Provide isolators in the control panels for all 4 to 20 mA signals to prevent ground loop problems, i.e., 4 wire transmitter with grounded signal common or loading problems. Isolators shall be modular design to allow easy replacement of the unit.

B. Spare Parts:
1. Provide 4 spare isolators of each type.

C. Manufacturers:
1. AGM
2. Action Instruments.
3. Approved equal.

2.12 PROCESS INDICATORS

A. Construction:
1. Provide digital indicators capable of accepting a 4 to 20 mAdc analog signal and provide continuous indication on the front panel space. The indicator shall be provided in nominal 2-inch by 4-inch case suitable for panel mounting. Display shall be in engineering unit calibrated by multi-turn pats and non-soldered jumpers.

B. Spare Parts:
1. (Not Used)

C. Manufacturers:
1. Action Instruments.
2. Red Lion.
3. Approved equal.

2.13 LIGHTNING AND SURGE PROTECTION

A. Analog:
1. All 4 to 20 mA analog signals shall be protected by common mode suppressor diodes.
   a. Suppressor diode clamping voltage shall not exceed 1.8 times operating voltage.
   b. Diodes shall be premounted in double level terminal blocks. Terminal blocks shall be provided with knife disconnects to allow user to monitor and test loops without removing wires, or breaking the loop.
   c. All loop power supplies must have the negative lead grounded to allow discharge of overvoltages.
   d. Manufacturers:
      1) Phoenix Contact Type UKK5-M.
      2) Approved equal.
2. All data highway communications shall be protected by full common mode, and normal mode protection techniques to include metal oxide varisters, surge suppressors diode, gas discharge surge suppressors and coil/chokes

B. Control Panel Power
1. All surge suppressors called out on the drawings shall be protected by full common mode, and normal mode protection techniques to include metal oxide varisters, surge suppressors diode, gas discharge surge suppressors and coil/chokes.
   a. Provide inline fuses with the surge suppressors to protect the equipment from long duration surges.
2. Manufacturers:
   a. Phoenix type UBK (control panels).
   b. Joslyn Model 16690-02 (field equipment)
   c. Approved equal.

2.14 INTRINSIC BARRIERS

A. Construction:

1. For hazardous location installation, Intrinsic Barriers can be used to limit current/voltage to the hazardous area, as well as provide a high integrity and low impedance return path for any fault current.
    a. Intrinsic Barriers shall consist of encapsulated shunt-diode configuration, using conventional diodes, zener diodes, current limiting resistors, and fuses.

B. Spare Parts:
1. Provide 4 spare Intrinsic Barriers of each type.

C. Manufacturers:
1. MTL Incorporated.
2. Approved equal.

2.15 TIMING RELAYS

A. Construction:
1. Relay coil voltage 120 VAC, 60 Hertz.
2. Relay shall be solid state, timing ranges and type of delay (on, off, etc) shall be made by changing out plug inserts into the relay base.
3. A minimum of two (2) timed contacts per relay shall be provided.
4. Relays shall plug into an 8 or 11 pin octal single tier screw terminal socket.

B. Spare Parts:
1. Provide 10% spare, but not less than two (2) of each type.

C. Manufacturers:
1. Square D class 9050
2. Approved equal.

2.16 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Construction:
1. UPS shall be provided to power critical components in the cabinet such as PLC, Operator Interface, DC power supply, and other sensitive electronic equipment.
2. The UPS shall be mounted to an angle bracket and shall be securely fastened to prevent damage during shipment.
3. Lightning and surge protection: The UPS shall be tested using lightning standard per ANSI/IEEE C62.41 category A test (6000 volt spike and 3000 amp) and C62.45 test procedures. The UPS must reduce the input spike to no less than 3 volts on the output, for a 2000 to 1 spike attenuation.
4. Isolation (including output neutral to ground bonding): The UPS shall provide a true, separately derived power source as defined by National Electrical Code Article 250-5d with output neutral bonded to ground. There shall be no direct connection between input and output and less than 2 pF of effective input to output capacitance.
5. Regulation: The UPS output shall be regulated to within the CBEMA and ANSI C84.1 point of utilization range of 104 to 127 VAC over the full dynamic range

from no load to full load, low line VAC to high line VAC, and low battery voltage to high battery voltage.

6. Continuous, no break power: The UPS shall provide continuous, no break power during a power outage or momentary interruption. Standby power systems which have any measurable transfer time and interruption of the output wave form are unacceptable.
7. Sine-Wave Power: The UPS shall provide computer-grade sine-wave power with 5 percent or less total harmonic distortion capability. It must meet or exceed CSA standard 22 Part 2-107 for harmonic distortion.
8. Switch-Mode Power Supply: Rated capacity shall be in volt amperes (VA) white loaded with typical computer-grade switch-mode power supplies having a power factor of 0.5 to 0.7 and crest factor of 2.7 to 3.5.
9. UPS is to be sized to maintain power to the PLC and sustain control power to the I/O for a minimum of 4 hours under full load.

B. Spare Parts:
   1. Not used

C. Manufacturers:
   1. Powerware.
   2. Approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All components must be installed within the control panel enclosure in a controlled environment in the panel factory in accordance with manufacturer's instructions and approved drawings. The control panel shall be pre-wired before delivery to the job site. Field modifications to existing equipment or in wiring required shall be the responsibility of the Contractor. Fieldwork shall be performed under the prevailing labor condition.

B. Verify from the control panel Supplier the maximum and minimum temperature and maximum relative humidity for storing the equipment, and conform to the Supplier's requirements. In any case, the minimum storage requirements will be not less than 50 degrees F. Protect the equipment from humid conditions which might cause corrosion of the electrical and electronic parts of the equipment by providing desiccant cartridges in enclosures and power to heaters. Failure to store equipment in the specified or approved manner shall be sufficient reason for not accepting the equipment, regardless of the outside appearance or warranty of the manufacturer. Protect all electronic equipment from a dusty environment by sealing the equipment in plastic, etc.

C. Verify type, quantities and locations of wiring required to interconnect system components and panels. Supplier will supply Engineer with copy of results before installation.

D. All installation of the control panels shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

E. Install units on concrete bases and/or grating and secure with anchor bolts in accordance with the manufacturer's recommendations.

F. The Contractor shall be responsible for installation of all the work required to provide a complete operating system.

G. The Contractor shall be responsible for, but not limited to, the following:
1. Assemble, wire and test all equipment.
2. Prepare interconnecting wiring diagrams, identification for all field equipment and radio connections.
3. Prepare panel fabrication drawings.
4. Programming system software to insure a complete operating system

H. No form of energy shall be turned on to any part of the system prior to receipt by the Engineer of a certified statement of approval of the installation from the Contractor containing authorization for turning on energy to the system.

3.2 SOURCE QUALITY CONTROL

A. If required for a Manufacturer-supplied control panel, a complete factory test of the entire control system prior to its shipment to the job site performed by Manufacturer, Owner, and Engineer at the manufacturer's facility. Written approval for shipment following acceptance of the factory test by Engineer.

B. System manufacturer using simulated inputs to assure all inputs, outputs, and application software are functioning according to the intent of the plans and specifications is the primary test objective. Simulated system faults and failures are also testing objectives.

C. Demonstrate all functions of the system.

D. Provide at least a two-week written notification to the Engineer prior to the start of the witnessed factory test.

3.3 FIELD QUALITY CONTROL

A. Site Tests
1. Calibrate all transmitters and receivers to imposed input values representing 10%, 50% and 80% of full scale. Verify the zero and span calibration of all transmitters. Where totalizers are part of the flow measuring system, calibrate at least three (3) points of imposed inputs covering the range of the units. Use differential heads developed by manometers as inputs in the case of flow meters, measured level or pressure in other cases. Adjust the receiving devices to read the calibrated output of the initial calibration. After placing each measuring system in service, connect a manometer to the test connections provided in the piping and make an actual comparison of the measured variable to readout. Each system must meet the accuracy indicated in the Specifications.
2. Adjust secondary functions, such as alarm actuation and pacing, during initial calibration and demonstrate proper calibration after the system is placed in service.

Seal linkage or range adjustments by colored lacquer in the presence of the Engineer immediately following calibration.

3. Conduct process calibration, such as volumetric draw down tests to check flow measurement and totalization and level measurements, on all measuring systems as requested by the Engineer. Provide the necessary gauges and assistance in making these tests.
4. Test all control systems, operation of all level transmitters and probes, solenoid valves and automated valves in all modes of operation and demonstrate successful performance.
5. Provide a supplier's representative on site during Preliminary and Final Mechanical Performance Testing.
6. Provide field service representative of the distributed logic control equipment manufacturer to verify that instruments have been properly installed, configured, and meet the manufacturer's qualifications for warranty.

B. Final Performance and Acceptance Test

1. Provide the services of a factory trained and field experienced instrumentation engineer to assist the Owner's personnel during the start-up of the plant process. The purpose of this assistance is to support making final adjustments of settings on the instrument systems prior to performing the demonstrations and final operational testing. Notify the Engineer in writing, a minimum of five (5) working days prior to the proposed date for commencing the Final Performance and Acceptance Test.
2. Upon completion of instrument calibration and system verification, test all systems under process conditions. The intent of this test is to demonstrate and certify the operational interaction of the instrument systems. Testing shall include, but not limited to, taking process variables to their limits (simulated or actual process) to verify all alarms, failure interlocks and/or transfers, and operational interlocks.
3. Immediately correct defects and malfunctions with Engineer approved methods and materials and repeat the test. Upon completion of the final operational testing, submit the test results and a certified report indicating that all required system tests have been completed satisfactorily and the systems meet the functional requirements of their applicable specifications.
4. Following final operational testing, the system shall operate without a system fault for 30 consecutive days to qualify for Final Acceptance. The Final Performance and Acceptance Tests shall be witnessed, documented, and signed off upon satisfactory completion by the Engineer.

3.4 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

B. Coordinate with the Owner’s System Integrator to ensure that Control Panel communicates with the Plant SCADA network.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

SECTION 409000 – INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Section Includes: General requirements for instrumentation devices and the Input/Outputs required for each device.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings

ASME PTC 19.5 (1972) Application Part II of Fluid Meters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126 (1993) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM B 61 (1993) Steam or Valve Bronze Castings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700 (1990; Addendum 1991) Cold-Water Meters - Displacement Type, Bronze Main Case

AWWA C704 (1992) Propeller-Type Meters for Waterworks Applications

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441 (Rev. B; Supp. 1) Paint, Epoxy-Polyamide

1.4 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. Details of interconnecting wiring, terminations, ratings, etc.

C. Source Quality Control Submittals: Results of required calibrations.

D. Site Quality Control Submittals: Written report giving the results of the required field calibrations and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

E. All programming software, licenses, cables, hardware, and software keys, and documented programs to be licensed in the owner's name and turned over to the owner after start-up and checkout completion.

F. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.

B. Any instruments that are not stored in strict conformance with the Manufacturer’s recommendation shall be replaced.

1.6 PROJECT OR SITE CONDITIONS

A. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.7 WARRANTY

A. Provide manufacturer’s standard warranty in accordance with Division 1.

1.8 MAINTENANCE

A. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all these supplies before project substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.

2.2 Ultrasonic Flow Meters:

A. MANUFACTURERS
1. Refer to the Instrument List Below for Basis of Design Manufacturer and Models.
2. Approved Equal.

B. Design and fabrication:
1. The ultrasonic transducers shall be manufactured with Titanium Gr. 2.
2. The unit shall be globally certified to methane, propane, ethylene, and butane and shipped from the factory set and calibrated to one of these gases.
3. The devise shall be globally certified for use in Class I, Divisions 1 and 2, and Zones 1 and 2 hazardous areas.
4. The device shall have a stainless-steel construction, sapphire optics, and modular design for easy installation and low cost of ownership.
5. The device shall have an explosion-proof, stainless steel housing with tethered weather protection baffle.
6. The device shall have an integral wiring compartment, eliminating the need for external junction boxes.
7. The unit shall have FM, CSA, ATEX, IECEx, DNV/MED, and INMETRO certifications and be certified to GM/CSA Class I, Div. 1, and ATEX/IECx Ex db, be protection standards for maximum versatility.
8. Backlit Display with touch control and WLAN access
9. Provide flanged end connections per ANSI B16.5 rated for piping system operating and test conditions.
10. Nominal Flange Diameter: 4’’
11. The transmitter electronics and software shall evaluate and condition the sensor signals and convert them into measurement variables. The variables shall include volume flow, corrected volume, and mass flow. An optional Advanced Gas Analysis package is available and can provide additional variables such as corrected methane volume, energy flow, methane fraction, calorific value, density, and dynamic viscosity, and Wobbe index.
12. 4-20 mA DC isolated output.
13. Power supply: 24 VDC Power.
14. Indication of flow rate and totalized flow at transmitter.
15. Volume Flow (Standard): ±1.0% for 3 to 40 m/s (9.84 to 131.23 ft/s)
±2 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)
Corrected volume flow (standard): ±1.5 % o.r. for 3 to 40 m/s (9.84 to 131.23 ft/s)

±2.5 % o.r. for 0.3 to 3 m/s (0.98 to 9.84 ft/s)

16. Measuring Range: 0.3 m/s to 40 m/s
17. Medium temperature range: -50 to 150 °C (-58 to +302°F)
18. Max. process pressure: 0.7 to 101 bar a (10.15 to 1464.88 psi a)
19. Wetted Materials: Measuring tube: 1.4408/1.4409 (CF3M)
    Transducer: 1.4404 (316, 316L), Titan Grade 2

C. Instrument List

Ultrasonic Flow Meters					
	Units	SCFM	SCFM	SCFM	SCFM
Connection	**Type**	Flange	Flange	Flange	Flange
	Size	4''	4''	4''	4''
	Wetted Material	Titanium/316L	Titanium/316L	Titanium/316L	Titanium/316L
	Signal	4-20 mA	4-20 mA	4-20 mA	4-20 mA
	Power	24VDC	24VDC	24VDC	24VDC
	Model No.	Proline Prosonic Flow G300	Proline Prosonic Flow G300	Proline Prosonic Flow G300	Proline Prosonic Flow G300
	Manufacturer	Endress+Hauser	Endress+Hauser	Endress+Hauser	Endress+Hauser
	Instrument Type	Ultrasonic Flow Meter	Ultrasonic Flow Meter	Ultrasonic Flow Meter	Ultrasonic Flow Meter
	Supplied By	Contractor	Contractor	Contractor	Contractor
	Description	Biogas Flow Tank T-001	Biogas Flow Digester 1 (T-002)	Biogas Flow Digester 2 (T-003)	Biogas Flow Digester 3 (T-004)
	Tag No.	FIT-001	FIT-002	FIT-003	FIT-004

2.3 Absolute Pressure Transmitter

A. Manufacturer:
1. Refer to the Instrumentation List below for Basis of Design Manufacturer and Models.
2. Approved Equal.

Design and Fabrication:
1. Manufactured Units
   a. The transmitter shall be a 2-wire, high-performance piezoresistive pressure transmitter with digital communications capabilities including HART.
   b. Measures millivolt changes in the sensor as pressure varies and produces a linear 4-20mA DC output proportional to the pressure. The unit shall have self-diagnostic capability and a non-volatile memory.
   c. Display shall be an integrally mounted 4-line LCD scaled with engineering units.
   d. Transmitter shall have a static pressure limit at least 1.5 times the nominal pressure range. Unit shall use DC loop-power supply 10.5 to 45 VDC with self-diagnostic capability and a non-volatile memory.
   e. Sensor shall be a piezoresistive, oil-filled element with metal process diaphragm.
   f. The unit shall be rated for process temperature of minus 40°F to 257°F and an ambient environment of -40 degrees F to 185 degrees F.
   g. Reference accuracy shall be +/- .075% of calibrated span including non-linearity hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including non-linearity hysteresis and non-reproducibility in addition to thermal change of the zero point shall be +/- .25% of adjusted span.

h. Unit shall have ATEX, FM, CSA or IECEx approvals as required.
i. The transmitter shall be programmable via hand-held device or shall have Bluetooth wireless technology interface and can be operated and configured via this interface using the SmartBlue app. Bluetooth shall have both encrypted communication and password encryption for security purposes. The Bluetooth wireless technology interface can be deactivated.

C. Accessories
1. Mounting set for installation of the transmitter on a wall or pipe

D. Source Quality Control
1. Factory calibration of each pressure sensor traceable to the National Institute of Standards and Technology (NIST).
2. A real-time computer-generated printout of the actual verification data indicating apparent and actual pressures at 0 percent, 50 percent and 100 percent of the calibrated range shall be included with each device.
3. Provide ISA data sheet ISA-TR20.00.01. Use the latest revision of form 20P2201. Complete the form with all known data and dash out the inapplicable fields. Incomplete data sheets submitted will be result in a rejected submittal.

E. Safety
1. All electrical equipment shall meet the requirements of ANSI/NFPA 70, NATIONAL ELECTRIC CODE, latest edition.
2. All devices shall be certified for use in hazardous areas: Class I, II, III Div. 1, 2, Groups A-G; temperature rating T6 (85° C)
3. Incomplete data sheets submitted will be result in a rejected submittal.

F. Instrument List

Pressure Transmitters					
Range	**Units**	PSI	PSI	PSI	PSI
Connection	**Type**	Thread	Thread	Thread	Thread
	Signal	4-20 mA	4-20 mA	4-20 mA	4-20 mA
	Power	24VDC Loop Power	24VDC Loop Power	24VDC Loop Power	24VDC Loop Power
	Model No.	Cerabar PMP51B	Cerabar PMP51B	Cerabar PMP51B	Cerabar PMP51B
	Manufacturer	Endress+Hauser	Endress+Hauser	Endress+Hauser	Endress+Hauser
	Instrument Type	Pressure Transmitter	Pressure Transmitter	Pressure Transmitter	Pressure Transmitter
	Supplied By	Contractor	Contractor	Contractor	Contractor
	Description	Biogas Pressure Tank T-001	Biogas Pressure Digester 1 (T-002)	Biogas Pressure Digester 2 (T-003)	Biogas Pressure Digester 3 (T-004)
	Tag No.	PIT-001	PIT-3-002	PIT-3-003	PIT-3-004

2.4 Gas Analyzer

A Manufacturer
1. Refer to attached Instrumentation List for Basis of Design Manufacturer and Models.
2. Approved Equal.

B. Manufactured Units
1. General Requirements
a. The gas analyzer solution must utilize dual sensor capability to continuously monitor potential toxic and combustible gasses in ambient air.

b. Gas analyzer shall actively monitor the integrity of each sensor, compensating for environmental factors that cause regular electrochemical sensors to drift.

2. Instrument Features
   a. Contains Organic LED (OLED) display and bright status LED's for extreme visibility
   b. Utilizes SafeSwap for safe and quick replacement of gas sensors without turning off the instrument.
   c. Dual sensor capability doubles the sensing power with half of the footprint of a single gas transmitter.
3. Environmental Requirements
   a. The gas analyzer solution must be capable of operating in a wide range of ambient temperatures, without impacting its analytical performance.
   b. The gas analyzer must be suitable for installation outside or in a cabinet for harsher environments.
4. Performance Requirements
   a. The gas analyzer must have an extremely low relative error rate and repeatability that is far below the 40 CFR Part 63 requirements.
   b. The gas analyzer must be able to automatically run analysis, calibration, or validation cycles using onboard software.
5. Additional Features
   a. Bluetooth wireless technology allows operator mobile device to act as an HMI screen and controller. The MSA Connect App is designed with high security standards and provides real-time information to operator mobile device. Operators have capability to:
      1. Check status and get alerts up to 75 ft. (23 m) away
      2. Reduce set up time by at least 50%

C. Source Quality Control
1. Factory calibration of each gas analyzer traceable to the National Institute of Standards and Technology (NIST).
2. A real-time computer-generated printout of the actual verification data indicating apparent and actual gas detection at 0 percent, 50 percent and 100 percent of the calibrated range shall be included with each device.
3. Provide ISA data sheet ISA-TR20.00.01. Use the latest revision of form 20P2201. Complete the form with all known data and dash out the inapplicable fields. Incomplete data sheets submitted will be result in a rejected submittal.

D. Safety
1. All electrical equipment shall meet the requirements of ANSI/NFPA 70, NATIONAL ELECTRIC CODE, latest edition.
2. All devices shall be certified for use in hazardous areas: Class I, II, III Div. 1, 2, Groups A-G; temperature rating T6 (85° C)
3. Incomplete data sheets submitted will be result in a rejected submittal.

E. Instrument List

Gas Analyzers		
Units	PPM & LEL	PPM & LEL
No. of Sensors	2	2
Sensor 1 Type	Combustible Gasses	Combustible Gasses
Sensor 2 Type	H2S	H2S
Signal	(2) 4-20 mA	(2) 4-20 mA
Power	24VDC	24VDC
Model No.	ULTIMA X5000	ULTIMA X5000
Manufacturer	MSA	MSA
Instrument Type	Gas Monitor	Gas Monitor
Supplied By	Contractor	Contractor
Description	Combustible Gas & H2S Detector Digester 2 Tunnel	Combustible Gas & H2S Detector Digester 3 & 4 Tunnel
Tag No.	AIT-002	AIT-003

2.4 H2S Analyzer

A. MANUFACTURER
1. KECO
2. Approved Equal

B. MANUFACTURED UNITS
1. General Requirements
a. The Gas Analyzer will be dependable no “false positive” requiring low maintenance.
b. The hydrogen sulfide H2S analyzer will provide continuous on-line process analysis based on the specific and interference free ASTM approved tape principle operation.
c. Flow meter and pressure regulator will be provided by the H2S Analyzer manufacturer to regulate pressure, and sample flow.
d. The principle of operation will be such as described in various ASTM methods including D4084-82, D4468-85, D4045-81.
e. Rateometric-colorimetric tape detector will be provided for up to one year supply.

2. DESIGN PARAMETERS
a. Displace will be alpha numeric LCD, 128-64 pixel with back lit display and LCD Graph Display including monthly data
b. Temperature ranges will be operable between 1°C and 50°C
c. Unit shall have an electrically isolated 4-20 mA signal.
d. Detection ranges shall be up to 2000 ppm H2S.
e. Panel shall be rated for Class 1 Division 2.
f. The analyzer shall be capable of operating in a wide range of ambient temperatures, without impacting its analytical performance
g. The analyzer shall be suitable for installation outside or in a cabinet.

2.5 Existing Instrumentation

A. Instrument Replacement

1. It is the responsibility of the Contractor to replace existing digester tank instrumentation in the Instrument List below with newly approved selected instruments. The contractor must verify the existing instrument locations, instrument model numbers, and instrument scaling in the field prior to instrument replacement. Instrument List shown below may not list all replacement instruments. It is the responsibility of the Contractor to coordinate with the owner to verify all existing tank instruments to be replaced. After approved equals are selected and procured, the final mounting locations of all replacement instruments are be coordinated with the owner.

B. Instrument List

EXISTING INSTRUMENT LIST						
Element	**Tag**	**Instrument Description**	**Manufacturer**	**Model Number**	**Eng Units**	**Terminating Panel**
LT	LT-25	T-001 Level Transmitter	Unknown	Unknown	Feet	IOP-3
PT	PT-25	T-001 Pressure Transmitter	Unknown	Unknown	'' H20	IOP-3
TT	TT-25	T-001 Temperature Transmitter	Unknown	Unknown	°F	IOP-3
LSAH	LSAH-30	T-002 Foam Level Switch	IFM Efector	LMT102	On/Off	IOP-4
PT	PT-30A	T-002 Liquid Level Pressure Transmitter	Endress+Hauser	PMC51-AA22II1PGJRLJJAA	'' H20	IOP-4
TT	TT-30	T-002 Dual Purpous Tank Temperature Transmitter	Endress+Hauser	TH13-8A12A2ABR1AK	°F	IOP-4
LSAH	LSAH-40	T-003 Foam Level Switch	IFM Efector	LMT102	On/Off	IOP-5
PT	PT-40A	T-003 Liquid Level Pressure Transmitter	Endress+Hauser	PMC51-AA22II1PGJRLJJAA	'' H20	IOP-5
TT	TT-40A	T-003 Dual Purpous Tank Temperature Transmitter	Endress+Hauser	TH13-8A12A2ABR1AK	°F	IOP-5
LSAH	LSAH-45	T-004 Foam Level Switch	IFM Efector	LMT102	On/Off	IOP-5
PT	PT-45A	T-004 Liquid Level Pressure Transmitter	Endress+Hauser	PMC51-AA22II1PGJRLJJAA	'' H20	IOP-5
TT	TT-45A	T-004 Dual Purpous Tank Temperature Transmitter	Endress+Hauser	TH13-8A12A2ABR1AK	°F	IOP-5

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish the services of an engineer representative of the manufacturer of the equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than 2 days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all equipment in accordance with the recommendations of the manufacturer.

3.2 FIELD TESTS AND INSPECTIONS

A. Test and calibrate in place the equipment to demonstrate that it meets the accuracy requirements for the full range as specified herein. Provide all labor, equipment, and incidentals required for the tests, including electric power and water required for tests. The Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest work affected by such deficiencies at the Contractor's expense. Record data from each field test shall be

recorded and documented in a formal field test report and submitted to the engineer. Final set-ups and findings shall be documented in the Operation and Maintenance manuals as well.

3.3 FIELD QUALITY CONTROL

A. Site Tests

1. Calibrate and test all instrumentation and provide documentation that the equipment has been certified to the Engineer.
2. Calibrate all transmitters and receivers to imposed input values representing 0%, 25%, 50%, 75%, and 100% of full scale. Verify the zero and span calibration of all transmitters. Where totalizers are part of the flow measuring system, calibrate at least three (3) points of imposed inputs covering the range of the units. Use differential heads developed by manometers as inputs in the case of flow meters, measured level or pressure in other cases. Adjust the receiving devices to read the calibrated output of the initial calibration. After placing each measuring system in service, connect a manometer to the test connections provided in the piping and make an actual comparison of the measured variable to readout. Each system must meet the accuracy indicated in the Specifications.
3. Adjust secondary functions, such as alarm actuation and pacing during initial calibration and demonstrate proper calibration after the system is placed in service. Seal linkage or range adjustments by colored lacquer in the presence of the Engineer immediately following calibration.
4. Conduct process calibration, such as volumetric draw down tests to check flow measurement and totalization and level measurements, on all measuring systems as requested by the Engineer. Provide the necessary gauges and assistance in making these tests.
5. Test all control systems, operation of all level transmitters and probes, solenoid valves and automated valves in all modes of operation and demonstrate successful performance.
6. Provide a supplier's representative on site during Preliminary and Final Mechanical Performance Testing.
7. Provide field service representative of the distributed logic control equipment manufacturer to verify that instruments have been properly installed, configured, and meet the manufacturer's qualifications for warranty.

B. Final Performance and Acceptance Test

1. Provide the services of a factory trained and field experienced instrumentation engineer to assist the Owner's personnel during the start-up of the plant process. The purpose of this assistance is to support making final adjustments of settings on the instrument systems prior to performing the demonstrations and final operational testing. Notify the Engineer in writing, a minimum of five (5)

working days prior to the proposed date for commencing the Final Performance and Acceptance Test.

2. Upon completion of instrument calibration and system verification, test all systems under process conditions. The intent of this test is to demonstrate and certify the operational interaction of the instrument systems. Testing shall include, but not limited to, taking process variables to their limits (simulated or actual process) to verify all alarms, failure interlocks and/or transfers, and operational interlocks.
3. Immediately correct defects and malfunctions with Engineer approved methods and materials and repeat the test. Upon completion of the final operational testing, submit the test results and a certified report indicating that all required system tests have been completed satisfactorily and the systems meet the functional requirements of their applicable specifications.
4. Following final operational testing, the system shall operate without a system fault for 30 consecutive days to qualify for Final Acceptance. The Final Performance and Acceptance Tests shall be witnessed, documented and signed off upon satisfactory completion by the Engineer.

END OF SECTION

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

SECTION 431100 – BIOGAS BLOWER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification sets forth the minimum essential characteristics and requirements for the Biogas Blower for this project. The Contractor shall install one (1) blower for Tank T-004 in the Base Bid to maintain operating pressure in Tank T-004 less than the rated MAOP of the existing cover.

B. Refer to the specification '262923 - Variable Frequency Motor Controllers.' Procure and install VFCs as specified.

C. This blower should be removed from the Add Alternate pricing as it is not required if the add alternate bid is included in the project scope.

1.2 WORK INCLUDED

A. Equipment furnished in this specification shall be fabricated and assembled in full conformity with this specification. The biogas blower shall be furnished complete with all mechanical equipment required for proper operation including control systems.

1.3 QUALITY ASSURANCE

A. Equipment manufacturer shall provide experienced field service personnel a total of 2 days and 1 trip for the installation checkout and startup of the equipment.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with General Conditions and include the following:

1. Complete assembly and installation drawings.
2. Descriptive information on material and equipment furnished.
3. Location of all appurtenances.

B. Submit O&M manual in accordance with the appropriate sections in these documents.

1.5 WARRANTY

A. Provide manufacturer's standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (Basis of Bid)

A. MAPRO International S.p.A./TMC Fluid Systems, Inc.

2.2 BLOWER REQUIREMENTS

A. BLOWER

1. The biogas blower shall be model CL22/01 VL, gas-tight in a stabilized aluminum alloy with double membrane lip ring in Viton on the shaft, sealing silicone rubber compound between the casing halves.

2. The blower shall have impregnation treatment of the blower casing halves, gas tight flanged suction filter, flanged elbows on inlet and outlet, expansion joints, and a condensate drain valve.

3. A 1-HP Premium efficiency, explosion-proof electric motor rated for 2479-rpm, explosion-proof (TEFC) motors suitable for 240/480-volt, 3-phase, 60-hertz.

4. Inlet and outlet connections shall be 2-½".

5. Working Conditions shall be:

   a. 60% Methane Gas
   b. Inlet pressure 1028-mbar (abs)
   c. Inlet Gas Temperature: 90-120°F
   d. Differential Pressure 25 mBar(g)
   e. Outlet Pressure: 1050-mbar (abs)
   f. Inlet Flow Rate: 100 scfm
   g. Adsorbed power: 0.52 kW

B. The Control Logic for the blower shall be housed within the Gas Holder (T-003) Control Panel 30-CP-003. Hardwired VFD signals for the blower are to be wired to additional IO spares in the panel.

1. The PLC shall provide the following minimum control logic.
   a. In the automatic mode, the biogas blower shall maintain a 2'' W.C. pressure in the gas holding space in T-004. The instrument measuring the gas holding space in T-004 is an existing instrument. The instrument tag is PT-45B, and it is currently wired to the IOP-5 Point IO PLC. This signal will need messaged to Gas Holder (T-003) Control Panel 30-CP-003 to be included in this control logic.
   b. The contractor supplied pressure transmitter "PIT-3-004" shall be integrated into the PLC control logic. This pressure transmitter monitors pressure on the discharge side of the blower. A high-level alarm shall be generated when this transmitter reaches a setpoint of 12'' W.C. Upon alarm activation, the biogas blower is to shut down, and remain shut down until the blower reaches a high alarm reset setpoint of 10'' W.C.
   c. A low-level alarm shall be generated when PT-45B reaches a setpoint of 1.0'' W.C. Upon alarm activation, the biogas blower is to shut down, and remain shut down until the blower reaches a low alarm reset setpoint of 2.5'' W.C. The low alarm signal shall also open the purge valve to relieve air chamber pressure.
   d. When the air chamber has been depleted (maximum gas storage), gas pressure will rise above the air chamber pressure. When gas pressure reaches a point approximately 2.5" W.C. the biogas blower will turn on.
   e. The blower shall be capable of being controlled entirely from both the plant SCADA system and locally at the VFC

PART 3 - EXECUTION

3.1 INSTALLATION AND TESTING

A. The biogas blower shall be installed by the Contractor in accordance with the plans and specifications.

B. Leak testing of the seals shall be performed by the system installer and witnessed by the owner or their representative.

C. Install units on concrete bases and/or grating and secure with anchor bolts in accordance with the manufacturer's recommendations.

3.2 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

END OF SECTION

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

SECTION 431346 – DIGESTER GAS HANDLING AND SAFETY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. General Requirements for Process Equipment – Section 460500

1.2 DESCRIPTION OF WORK

A. CONTRACTOR shall furnish all labor, materials, equipment and incidentals as shown, specified and required to furnish and install gas handling and safety equipment not specified in other sections.

1.3 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages. Control panels detailing interconnecting wiring, terminations, ratings, etc.

C. Product Certificates: Signed by manufacturers of gas safety equipment certifying that all products furnished comply with requirements.

D. Source Quality Control Submittals: Conveyor performance test results, results of required control panel shop tests.

E. Site Quality Control Submittals: Written report giving the results of the required field tests and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

F. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

1.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all equipment called for under this Section shall be supplied by a single manufacturer (Gas Safety Equipment Manufacturer).

B. Manufacturer Qualifications: Gas Safety Equipment Manufacturer shall have a minimum of ten years' experience producing substantially similar equipment and shall be able to show evidence of at least 20 installations in satisfactory operation for at least 5 years.

C. All components shall be specifically designed for wastewater service and shall be integrated into the overall equipment design by the Gas Safety Equipment Manufacturer.

1.5 WARRANTY

A. Provide manufacturer's standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Digester Gas Handling Equipment Manufacturers:
1. Varec
2. Shand & Jurs
3. Or Equal

B. Waste Gas Burner Manufacturers:
1. Varec
2. Shand & Jurs
3. Or Equal

2.2 DIGESTER GAS HANDLING EQUIPMENT

A. Condensate and Sediment Traps
1. Condensate and sediment trap shall have ANSI 150 FF flanged connections.
2. The operating principle for removing sediment from gas shall be centrifugal force developed by a circular motion of gas passing through at high velocities and gravity at low velocities. Inlet elbow shall be specifically designed to swirl the gas inside the reservoir. An internal baffle shall be located at the base of the reservoir to provide efficient separation of entrained droplets.
3. Sediment traps shall be designed for working pressures up to 5 psig.
4. Condensate/Sediment Trap shall provide minimum storage capacity of six gallons sediment and six gallons condensate.
5. A 2" NPT blowout/drain connection, a 1" NPT drain connection, and two 1/2" NPT connections for a sight glass shall be provided.

6. A removable top cover for interior access with integral 3/4" NPT inspection pipe for sediment level measurement shall be provided.
7. Construction shall be 316 Stainless Steel.
8. The sight glass shall have 1/2" NPT connections of the correct length to fit the sight glass connections on the Sediment and Condensate Trap. Sight tube shall be 5/8". Guard rods shall protect the sight tube. Assembly shall include two isolation valves to facilitate cleaning. Lower valve shall include a drain cock. Materials shall include stainless steel isolation valves, drain cock, and guard rods.
9. Condensate/Sediment Traps shall include a manual drip trap for removal of accumulated sediment.

B. Flame Arrester
1. Flame Arrester net free area through the bank assembly shall be not less than three times the corresponding size standard pipe. Entire bank assembly shall slide easily out of the arrester housing to facilitate inspection and cleaning. Removing or replacing the bank assembly shall not require support for alignment, jackscrew for extending the housing, and shall not place a strain on the connecting piping. Bank frame shall be extensible and shall be filled with corrugated rectangular shaped bank sheets.
2. Arrester housing construction shall be low copper cast aluminum. Bank assembly shall include a low copper aluminum frame and Type 316 stainless-steel sheets.
3. Flame arrester shall include an offset housing with a 1/2" NPT connection to allow condensate draining when installed in the horizontal position. Flame arrester for vertical installation shall be self-draining.
4. Flame arrester shall be leak proof to 10 psig.
5. Flanges shall be drilled to ANSI 150 (ASA 125) FF Flanged dimensions.
6. When installed outdoors, provide with a 1” thick insulating jacket. The insulating jacket is constructed with a silicone impregnated woven glass cloth lining with a 1” thick, 6-lb density fiber glass insulating material. The silicone lining has inside seams and folded closing seams with two parallel rows of stitching. The special made insulating jacket shall be attached to the unit with a combination of Velcro and cinch belts. The jacket must allow access to the flame arrester bank assembly during maintenance without removing the entire jacket.
7. Flame Arrester shall be Varec 5000/5010 Series or equal.
8. Spare Parts: Provide one (1) spare bank assembly element for each size of flame arrester installed.

C. Pressure/Vacuum Relief Valve
1. Provide combination pressure and vacuum relief valves where shown on the Drawings. Valves should be provided with flame arresters immediately upstream of the valve and will vent to atmosphere.
2. Body shall be Aluminum with Class 150 flanges and Type 316 stainless steel trim.
3. Valve design should allow for field reconfiguration of pressure setting by adding or removing weights.
4. Hood and cover shall be easily removable for inspection and maintenance.
5. Protective screens should be provided at both pressure and vacuum ports to prevent the entrance of foreign matter.
6. Provide “All-Weather” option including non-frosting and icing resistant coating on the pallet perimeter, stem, guide posts, and tip-of-seat ring.

7. Provide flexible PTFE seat insert.
8. When installed outdoors, provide with a 1" thick insulating jacket. The insulating jacket is constructed with a silicone impregnated woven glass cloth lining with a 1" thick, 6-lb density fiber glass insulating material. The silicone lining has inside seams and folded closing seams with two parallel rows of stitching. The special made insulating jacket shall be attached to the unit with a combination of Velcro and cinch belts. The jacket must allow access to the valve during maintenance without removing the entire jacket.
9. Dual pressure/vacuum relief valves shall be provided with Safety Selector Valve as a manual switch-over device. Safety selector valve shall be of aluminum construction with stainless steel trim and Teflon seals. Valve shall include red indicator to identify active process side.
10. Pressure/Vacuum Relief Valve shall be Varec 2011B Series or equal. (Varec 5811B with flame arrester)

D. Flame Check
1. Housing shall be of "pipe union" design to permit easy disassembly for inspection and cleaning. Element shall be replaceable and be made of compressed 316 SS woven wire. Housing shall be constructed of low copper cast aluminum. Maximum working pressure shall be 25 psig.
2. Flame check shall be Varec Model 5200 or equal.
3. Spare Parts: Provide one (1) spare element for each size of flame check installed.

E. Manual Drip Trap
1. Provide low pressure manual drip trap where shown on the Drawings for safe removal of condensate from biogas piping network.
2. Drip trap shall be suitable for working pressures up to 5 psig.
3. Provide 6-quart reservoir capacity with 1" inlet and outlet NPT connections.
4. Body shall be low copper cast aluminum and internal parts and hardware shall be Stainless Steel
5. Manual Drip Trap shall be Varec 246 Series or equal.

2.3 WASTE GAS BURNER SYSTEM

A. The Waste Gas Burner System shall be the candle-stick type flare with pilot ignition system designed to burn excess biogas as described below:

Parameter	**Inlet Biogas Conditions (Dry Basis)**
Peak Flow	300 scfm
Temperature	100 °F
CH_4	54.75% mol
CO_2	44.0% mol
N_2	1.0% mol
O_2	0.25% mol
H_2O	Saturated
H_2S	500 ppmv
Siloxane	< 40 ppbv

B. Prior to the Design of any structural member, the Contractor and/or the Waste Gas Burner manufacturer/supplier should verify all existing dimensions and conditions in addition to coordinating the final equipment dimensions with the Drawings and the approved adjacent Equipment Submittals.

C. The Waste Gas Burner and Supports shall be designed to withstand the minimum structural loads shown in Section 460500 per IBC 2018 and Minimum Design Loads and Associated Criteria for Buildings and Other Structures per ASCE 7 for the project site without exceeding the allowable design working stress of the materials involved, including anchors and connections.

D. Waste Gas Burner System shall include the following components:
1. Burner – Burner and stack shall be constructed of Type 304 stainless steel, with ANSI 150 RF flanges.
    a. Support Burner base for flare stack shall be provided.
    b. System supplier shall provide anchor bolt calculations for installation and mounting.
2. Pilot Ignition System with Blower
    a. Pilot system will use natural gas, which will be mixed with air and ignited at ground level, remote from the burner stack, and shall not be affected by changes the biogas flow rate or BTU content.
    b. Pilot system shall be designed for low pressure natural gas, less than 10 psig.
    c. During ignition, a blower will pre-mix air with the pilot gas to achieve the proper air/gas mixture required for combustion. Pilot shall remain lit under all flow and weather conditions.
    d. A sparkplug shall be located at the exist of the mixing chamber.
    e. A remote spark generator, housed in a NEMA 7 enclosure shall be provided.
    f. Pilot shall flow only on the continuous flame line when there is demand to combust biogas at the pilot.
    g. If pilot is lost, an automatic pilot reignition should attempt to reignite the flare.
    h. Pilot gas control system shall be capable of being mounted up to 70 feet from the burner.
    i. Blower package shall include all required pilot gas solenoid valves, regulators, and gauges to control the pilot gas.
    j. Blower shall include explosion proof motor and switch.
    k. A step-down pilot gas pressure regulator shall be provided.
    l. A Type 304 stainless steel mounting stand and Type 316 stainless steel weatherhood shall be provided for the selected ignition system.
    m. Low Pressure Pilot Ignition System shall be Varec 244WL series or equal.
3. Thermocouple – A Type 316 stainless steel thermocouple shall be provided in the continuous flame nozzle to control the shut-off of pilot gas in the secondary flame retention line.
4. Flow meter shall be included to measure flow of biogas to flare.
5. Back Pressure Regulator – A back pressure regulator shall be provided to control upstream pressure. The valve is normally closed and opens when upstream pressure reaches the setting to control flow of gas to the flare.
    a. Back Pressure Regulator shall be constructed of low copper aluminum with a spring-loaded nylon-reinforced BUNA-N diaphragm.

b. Pallet shall be low copper aluminum with Type 304 stainless steel stem and bushings.
c. Set pressure shall be adjusted by using a Type 304 stainless steel adjusting screw on top of the valve.
d. Regulator shall include a pointer to provide visual indication of the set pressure.
e. Regulator shall be suitable for a pressure setting range of 7 – 11 inches WC.
f. The regulator shall include a ½" NPT connection for a sensing line to be installed upstream of regulator.
g. Regulator shall be installed with additional flame arrester, as specified above.
h. When installed outdoors, provide with a 1" thick insulating jacket. The insulating jacket is constructed with a silicone impregnated woven glass cloth lining with a 1" thick, 6-lb density fiber glass insulating material. The silicone lining has inside seams and folded closing seams with two parallel rows of stitching. The insulating jacket shall be attached to the unit with a combination of Velcro and cinch belts. The jacket must allow access to the valve and flame arrester bank assembly during maintenance without removing the entire jacket.
i. Back Pressure Regulator shall be Varec 386 Series or equal.

6. Flame Trap Assembly – A flame trap assembly shall be installed on the line to the flare to prevent a flame flashback.
   a. Assembly shall include thermal shut-off valve and flame arrester. Unit shall be suitable for installing in horizontal or vertical piping.
   b. Thermal valve shall include a fusible element designed to close the valve within 15 seconds upon reaching 260°F.
   c. Fusible element shall control a spring-operated pallet. An isolated sight glass shall be provided so that pallet position can be determined without having to remove the valve from service. Fuse plug shall be gas tight and shall be removable for replacement of the fusible element.
   d. Valve construction shall be low copper cast aluminum body and cover. Inner valve shall include low copper aluminum pallet assembly, with 304 stainless steel compression spring. Sight glass shall be acrylic with neoprene gaskets.
   e. Flame Arrester net free area through the bank assembly shall be not less than three times the corresponding size standard pipe. Entire bank assembly shall slide easily out of the arrester housing to facilitate inspection and cleaning. Removing or replacing the bank assembly shall not require support for alignment, jackscrew for extending the housing, and shall not place a strain on the connecting piping. Bank frame shall be extensible and shall be filled with corrugated rectangular shaped bank sheets. Flame arrester shall include an offset housing with a 1/2" NPT connection to allow condensate draining when installed in the horizontal position.
   f. Arrester housing construction shall be low copper cast aluminum. Bank assembly shall include a low copper aluminum frame and stainless-steel sheets.
   g. When installed outdoors, provide with a 1" thick insulating jacket. The insulating jacket is constructed with a silicone impregnated woven glass cloth lining with a 1" thick, 6-lb density fiber glass insulating material. The silicone lining has inside seams and folded closing seams with two parallel rows of stitching. The insulating jacket shall be attached to the unit with a

combination of Velcro and cinch belts. The jacket must allow access to the flame arrester bank assembly during maintenance without removing the entire jacket.

h. Flanges shall be drilled to ANSI 150 (ASA 125) FF Flanged dimensions.
i. Thermal shut-off and flame arrester shall be factory assembled as one unit. Maximum working pressure is 5 psig.
j. Flame Trap Assembly shall be Varec 450 Series or equal.

7. Spare Parts: Provide one (1) spare bank assembly element for each size of flame arrester installed.
8. Flame Check – Low pressure flame checks as specified above shall be provided on any small diameter vent or sensing lines.
9. Control Panel – Waste Gas Burner System shall be supplied with a control panel.
   a. The control panel will contain the necessary control devices and equipment for controlling the Waste Gas Burner System as described herein shall meet the requirements in Section 406716: Process Control Panel & Hardware and Section 406343: Programmable Logic Controllers.
   b. Enclosure: NEMA 4X, 316 stainless steel
   c. Power supply: 120VAC
   d. Panel shall include PLC with HMI touch screen.
   e. Panel shall include a heater and thermostat.
   f. The following remote alarm contacts shall be provided:
      1) Pilot out
      2) System alarm

PART 3 – EXECUTION

3.1 INSTALLATION

A. All installation of the equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

B. All equipment must be installed in accordance with manufacturer's instructions and approved drawings.

C. Install units on concrete bases and/or grating and secure with anchor bolts in accordance with the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's factory-trained representative, who is specifically knowledgeable in the type of equipment specified herein, shall check and approve the installation prior to operation, including proper alignment. Manufacturer's representative shall field test and adjust the equipment to assure that the system operates to the OWNER'S satisfaction.

3.3 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

B. Upon satisfactory completion equipment startup per Section 460500, a representative of the manufacturer shall be provided to instruct Owner's personnel in the proper operation and maintenance of the equipment, in accordance with Section 017500. The manufacturer's representative who will be providing the instruction shall have prior operation, maintenance and instructing experience. The representative shall then provide two (2) 8-hour days for operator training exclusive of installation, start-up, and testing support.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 432600 - SPECIALIZED LIQUID PUMPS – DRY PIT CHOPPER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 40 – Process Integration (Control Panels)

C. General Requirements for Process Equipment – Section 460500

1.2 DESCRIPTION OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install a jet mixing system to completely mix T-001, T-002, and T-003. Refer to Contract Drawings for tank diameters, bottom cone depth, minimum and maximum side water depths.

B. Refer to the specification '262923 - Variable Frequency Motor Controllers.' Procure and install VFCs as specified.

C. A third jet mixing system for Tank T-004 may or may not be included for this project based on the overall lowest bid and add alternate pricing. Tank T-004 jet mixing system add alternate bid consists of the specifications listed herein and on the contract drawings.

D. Each digester shall consists of a chopper pump and all appurtenances required for operation. The pump shall be specifically designed to pump waste solids at heavy consistencies. Materials shall be chopped and conditioned by the pump as an integral part of the pumping action.

1.3 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. CFD Analysis report for each tank. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

C. Product Certificates: Signed by manufacturers of gas mix systems certifying that all products furnished comply with requirements.

D. Source Quality Control Submittals: Jet mix system performance test results, results of required control panel shop tests.

E. Site Quality Control Submittals: Written report giving the results of the required field tests and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

F. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

G. Submit certified capacity and power requirements of the gas compressor.

H. Submit bearing life information where applicable for the compressor drive system.

I. Design loadings to be transmitted to foundations for supports.

J. Significant dimensional differences between the equipment and specified herein indicated on the drawings and the proposed equipment.

1.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all equipment called for under this Section shall be supplied by a single manufacturer (Jet Mix Equipment Manufacturer).

B. Each mixer system shall be furnished complete with all supports; all mechanical equipment required for proper operation, including complete pump with drive units and all additional materials or fabrication as required by the supplier’s design.

C. Manufacturer Qualifications: Jet Mix Manufacturer shall have a minimum of ten years’ experience producing substantially similar equipment and shall be able to show evidence of at least 20 installations in satisfactory operation for at least 5 years.

D. All components shall be specifically designed for wastewater service and shall be integrated into the overall equipment design by the Jet Mix Equipment Manufacturer.

1.5 WARRANTY

A. Provide manufacturer’s standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers (Basis of Bid):
   1. Vaughan Co., Inc.
   2. JDV

2.2 GENERAL CRITERIA

A. Pumps: Provide factory tested pumps, thoroughly cleaned and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed in the pump schedule. Provide pumps of the same type by same manufacturer.

B. Motors: Provide motors as specified for each type of pump application. Horsepower rating shall suit pump requirements and be non-overloading throughout the entire operating range.

C. Foundations: Furnish foundation bolts as recommended by pump manufacturer, for proper positioning during placement of the concrete. The pumps shall be mounted on concrete pad of sufficient thickness to permit one inch of grout under pump for setting of elevations shown on the drawings.

D. Gauges: The suction and discharge flanges shall be drilled and tapped for mounted gauges. Each connection shall be provided with a ½-inch male and female petcock connection. A 2-inch gauge shall be provided for each pump discharge. Gauges shall be in a rustproof case connected with brass piping and valves. The gauge scales shall be uniformly marked in feet of water and psi in a range adequate for each pumping unit. Each gauge shall be provided with a disconnect valve and isolation diaphragm suitable for wastewater service.

E. Safety Requirements: All gears, chains, couplings, projecting set screws, keys and similar rotating or reciprocating parts shall be protected in accordance with American Standard Association Safety Code for Mechanical Power Transmission Apparatus B15-1927.

F. Stainless steel nameplates giving the name of the manufacturer, the Jet mix system model and serial number and material code shall be attached to each unit.

G. All working parts of the pumps and motors, such as bearings, wearing rings, shaft sleeves, etc., shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the OWNER may, at any time in the future obtain replacement and repair parts for those furnished in the original machines.

H. The nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed.

I. Mechanical equipment including drives and electric motors shall be supplied and installed accordance with applicable OSHA regulations. The noise level of motors, unless otherwise noted, shall not exceed 85 dBA measured 3 meters from the unit under free field conditions while operating on utility power.

J. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards.

K. The panel shall incorporate an Allen Bradley Compact Logix or equal Programmable Logic Controller (PLC) for accomplishing the control logic.

L. Prior to the Design of any structural member, the Contractor and/or the Jet Mix System manufacturer/supplier should verify all existing dimensions and conditions in addition to coordinating the final equipment dimensions with the Drawings and the approved adjacent Equipment Submittals.

M. The Jet Mix System and supports shall be designed to withstand the minimum structural loads shown in Section 460500 per IBC 2018 and Minimum Design Loads and Associated Criteria for Buildings and Other Structures per ASCE 7 for the project site without exceeding the allowable design working stress of the materials involved, including anchors and connections.

N. Sharp corners of all cut and sheared edges shall be made smooth by a power grinder.

2.3 DRY PIT CHOPPER PUMPS

A. Design and Construction

1. The following schedule list pumps to be provided and installed:

Parameter	T-001 Jet Mix Pump (Base Bid)	T-002 Jet Mix Pump (Base Bid)	T-003 Jet Mix Pump (Base Bid)	T-004 Jet Mix Pump (ADD Alternate)
No. of Pumps	1	1	1	1
Location	New FRP Encl.	Digester Tunnel	Digester Tunnel	Existing Mixer Pit #3
Pump Configuration	Horizontal	Horizontal	Horizontal	Vertical
Design Point #1	1400 gpm @ 35’	2400 gpm @ 35’	2400 gpm @ 35’	2400 gpm @ 35’
Fluid	Thickened Sludge @6% TS	Thickened Sludge @6% TS	Thickened Sludge @6% TS	Thickened Sludge @6% TS
Suction Flange	6”	8”	8”	8”
Discharge Flange	8”	10”	10”	10”
Motor Size	15 HP	40 HP	40 HP	40 HP
Motor Speed	1180 RPM	1180 RPM	1180 RPM	1180 RPM
Model	HE6W8CS-120	HE8N10CS-120	HE8N10CS-120	PE8N10CS-120
Electrical Rating	-	Class 1 Div 2	Class 1 Div 2	Class 1 Div 2

B. Casing, Backplate and Wearplate: The pump casing shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. A pressure tap shall be included on or near the discharge flange. Backplate shall allow for removal of pump components from outboard of the casing and allow external adjustment of impeller-to-cutter bar clearance. Casing and backplate shall be cast ductile iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Backplate will include a replaceable Rockwell C60 steel wearplate with internal cutter groove, and adjustability to maintain 0.030-0.050" clearance to cut against the rotating impeller pump-out vanes for removing fiber and debris from the mechanical seal area.

C. Impeller: Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015"- 0.025". Impeller shall be cast steel, heat treated to minimum Rockwell C60 and dynamically balanced. The impeller shall be threaded to the shaft and shall have no axial adjustments and no set screws. Pumps with open type impellers or impellers without modified pump out vanes to shear against the upper cutter shall not be acceptable.

D. Cutter Bar: Shall be recessed into the pump bowl and contain at least 2 shear bars extending diametrically across the intake opening to within 0.025”-0.050” of the rotating external cutter tooth, for the purpose of preventing debris from wrapping and blocking the intake opening. Cutter bar shall be steel heat-treated to minimum Rockwell C60. Chopper pumps utilizing individually mounted shear bars shall not be acceptable.

E. External Cutter: The external cutter shall be used to eliminate binding or build-up of stringy materials at the pump inlet. The external cutter shall consist of opposing cutter wings which shear against the outside surface of the shear bars and the anvil, an integral cast tooth which shears against the adjacent surface of the shear bars, and a hex head sufficiently sized for ease of removal. The external cutter shall be cast alloy steel and heat treated to a minimum Rockwell C60. Chopper pumps which do not have a rotating external cutter extending through to the opposite side of the shear bar and lack the ability to cut debris from the pump suction shall not be acceptable.

F. Upper Cutter: Shall be bolted into the backplate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel, heat treated to minimum Rockwell C60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.6 or less.

G. Pump Shafting: The pump shaft and impeller shall be supported by rolling element bearings. Shafting shall be heat treated alloy steel.

H. Bearings: Shaft thrust in both directions shall be taken up by angular contact ball bearings, or tapered roller bearings, mounted in an adjustable position thrust bearing cartridge to permit upper cutter to impeller adjustment. A single spherical roller radial bearing shall also be provided. L-10 bearing life shall be minimum 100,000 hours.

I. Bearing Housing: Shall be cast ductile iron and machined with piloted bearing fits for concentricity of all components. Bearing housing shall include a side-mounted oil reservoir. Viton® double lip seals riding on stainless steel shaft sleeves are to provide sealing at each end of the bearing housing.

J. The mechanical seal is to be manufactured and warranted by the pump manufacturer. Pump manufacturer is to have at least 15 years’ experience producing the mechanical seal and a documented history of 10 years of installations in the same application as specified. Mechanical Seal specifically designed to require no seal flush: The mechanical seal shall be located immediately behind the impeller hub to eliminate the stuffing box and maximize the flushing available from the impeller pumpout vanes. The seal shall be cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This

cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and ductile iron seal housing.

K. Shaft Coupling: Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be TB Woods Sureflex elastomeric type.

L. Vendor to provide air release valves as recommended for the piping system. Contractor to install as per Vendor requirements.

2.4 Motor Requirements

A. Each unit shall consist of a base frame mounted pump / geared motor configuration and shall be complete with electric motor, 1800 RPM, 3 phase, 60 hertz, 1.15 service factor, TEFC enclosure, C-face foot and flange mounted premium efficient motor. The motor shall be sized for non-overloading conditions at all acceptable operating points on the pump performance curve.

2.5 Motor Controllers:

A. Motor Starters shall be provided for each pump as shown on the Drawings and as specified in Specification Section 262419: Motor Control Centers.

B. Variable Frequency Drives shall be provided for each Pump as shown on the Drawings and as specified in Specification Section 262923: Variable Frequency Motor Controllers.

2.6 Spare Parts and Tools:

A. Manufacturer shall furnish a list of recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

B. Furnish lubricant and oil and grease as required for initial operation. Use products recommended by the manufacturer.

2.7 PERFORMANCE AND DESIGN REQUIREMENTS

A. The digester mixing system shall positively and continuously mix the entire contents of the digester. The variation in total solids throughout the digester shall not vary more than 10% standard deviation from the mean total solids for the digester when the mean total solids concentration in the digester is between 2% and 7% solids by weight. The sludge temperature shall not vary more than 1.0°F standard deviation from the mean average tank temperature.

B. The mixing system shall be designed to maintain an active digester volume excess of 90%.

2.8 MATERIALS

1. Unless otherwise specified, the materials used in the fabrication of the equipment under this section shall conform to the following:

Mixing Tube:	AISI 304, ASTM A167, 18-8
Bubble Generator:	AISI 304, ASTM A167, 18-8
Supports:	AISI 304, ASTM A167, 18-8
Bolts, Nuts, and Washers for Supports:	AISI 316, ASTM A167, 18-8

2.9 OPERATING PANEL AND CONTROLS

A. General: The pump will vary speed based on Operator Input. The Variable Frequency Drive shall be capable of being controlled entirely from the Plant Control System (SCADA).

B. Control Strategy: The pumps will be monitored and controlled by remote SCADA and local controls. The pumps shall run only when process liquid level is 1’ or more above pump suction line. Manufacturer will set minimum pump operating speed upon startup or shutdown to protect pump and motor from damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All installation of the Jet Mix equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

B. All equipment must be installed in accordance with manufacturer's instructions and approved drawings.

C. Install units on concrete bases and/or grating and secure with anchor bolts in accordance with the manufacturer's recommendations. Mixers shall be level within 1/8-inch.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's factory-trained representative, who is specifically knowledgeable in the type of equipment specified herein, shall check and approve the installation prior to operation. Manufacturer's representative shall field test and adjust the equipment to assure that the system operates to the OWNER'S satisfaction.

3.3 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

B. Upon satisfactory completion equipment startup per Section 460500, a representative of the manufacturer shall be provided to instruct Owner's personnel in the proper operation and maintenance of the equipment, in accordance with Section 017500. The manufacturer's

representative who will be providing the instruction shall have prior operation, maintenance and instructing experience. The representative shall then provide two (2) 8-hour days for operator training exclusive of installation, start-up, and testing support.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 460500 – GENERAL REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 46 Specifications

1.2 DESCRIPTION OF WORK

A. Common work requirements related to Water and Wastewater Process Equipment supplied by the Contractor for installation, commissioning and operation.

B. The size of equipment shown on the Drawings is based on information available to the ENGINEER at the time of design. Actual dimensions of equipment may vary depending on final equipment selection. Illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, equipment pads, connected piping, valves, and electrical conduit may have to be altered to accommodate the equipment provided.

1.3 SUBMITTALS

A. In accordance with Section 013300 - Submittals.

B. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

C. The submission and approval of each set of manuals is considered to be part of requirements for furnishing and installing the respective equipment or system. Incomplete or inadequate manuals shall be returned to the CONTRACTOR for correction and resubmission.

1.4 QUALITY ASSURANCE

A. Equipment Uniformity: Where like items are incorporated into equipment systems (i.e. blowers, pumps, etc.), such items must be identical to achieve standardization for appearance, operation, maintenance, spare parts, and service. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications

B. All components shall be specifically designed for wastewater service and shall be integrated into the overall equipment design by the equipment manufacturer.

C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards and shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operation.

D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

E. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

F. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

G. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components

PART 2 - PRODUCTS

2.1 GENERAL CRITERIA

A. All equipment shall be constructed of materials referenced under individual specification sections and as indicated on the Drawings.

B. All equipment shall have the Manufacturer's standard factory finish before delivery except where noted under individual specification sections. Finishes will comply with requirements of Division 9.

C. All structural steel shall have a minimum thickness of 1/4" and shall be coated as described in Division 9 and as specified herein.

D. All units shall be designed and rated (with sufficient safety factor) to comply with the applicable requirements of ASCE 7 and the site-specific Structural Design Criteria as shown on the Drawings. These are repeated as follows:

1. Applicable Code: 2021 Ohio Building Code Risk Category III
2. Minimum Ground Snow Load (P_g): 36 PSF
3. Minimum Flat Roof Snow Load (P_f): 28 PSF
4. Snow Importance Factor (I_s): 1.1
5. Thermal Factor (C_t): 1.0
6. Exposure Factor (C_e): 1.0
7. Snow Drift Load (P_d): None
8. Snow Drift Width (w): None
9. Ultimate Design Wind Speed (V_{ult}): 115 MPH
10. Nominal Design Wind Speed (V_{asd}): 93 MPH
11. Wind Exposure Category: B

12. Seismic Importance Factor (Ie): 1.00
13. Seismic Site Class: D
14. Seismic Design Category: B
15. Seismic Design Criteria:
    a. S_s 0.130g
    b. S_1 0.056g
    c. S_{DS} 0.11g
    d. S_{D1} 0.079g

E. Manufacturer to provide calculations and submittal to demonstrate compliance with applicable portions of ASCE-7 (latest edition) and those calculations shall be sealed by a Professional Engineer registered in the Ohio.

2.2 ANCHORS AND SUPPORTS

A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

B. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps).

2.3 MOTORS

A. Motors: Motors shall be of sufficient capacity to operate the driven equipment under all conditions of operation without loading beyond the nameplate current or power. The rating of motors offered shall in no case be less than the horsepower shown on the drawings or specified herein except when it can be demonstrated that because the efficiency of the driven equipment is greater than that specified, a lesser horsepower motor will suffice. Both the rating and the characteristics of the motor shall be suitable for the successful operation of the equipment driven under maximum load conditions.

B. Rating: Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Electrical Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

C. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

D. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

E. Specific motor data such as Hp, rpm, enclosure type, etc., is specified under the detailed specification for the equipment with which the motor is supplied.

F. Nameplates: The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MGI-10.38 or MGI-20.60, as applicable.

G. Anti-friction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperature of 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.

H. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type by the Alemite Division of the Stewart-Warner Corporation.

I. Insulation:
   1. Insulation systems shall be Class B or Class F, operated at Class B temperature rise and shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkali's and mechanical or thermal shock for 480 Volt motors. Provide 80 degree C, Class B rise or better by resistance at 100 percent load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40 degree C at no more than 3300 feet above sea level for medium voltage motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.
   2. Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
   3. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

J. Inverter Duty Motors: Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31 (1993). Consideration shall be given to the primary factors of the variable frequency drive such as the modulation scheme (six-step, PWM, etc.), the switching or carrier frequency and the type of power output devices utilized (IGBT etc.). Consideration shall also be given to the installation methods such as output cable length, cable installation method, installation of output filters, etc. Enclosures shall be equal to those furnished for sever duty or explosion proof motors. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.0 that of the nameplate. Ventilation system shall be designed for maximum heat transfer. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

K. Adjustable/Variable Frequency Drives: In applications with adjustable/variable frequency drives supplied by General Contractor and Manufacturer to coordinate with Electrical Construction, to ensure proper installation and operation. The design of each adjustable frequency drive shall be coordinated with the requirements of the process equipment. The equipment manufacturer shall be responsible for furnishing complete motor nameplate date, specifications on temperature

switches, motor space heater requirements, fluid detection specifications and wiring diagrams, and any other required data to the adjustable frequency drive supplier to ensure coordination between the equipment and drive. The same information submitted to the adjustable frequency drive supplier shall be included in the equipment submittal. The adjustable frequency drive supplier shall be responsible for receiving the data, reviewing it, and informing the equipment supplier if any additional data is required. A letter from the equipment manufacturer stating that the above information was sent to the adjustable frequency drive supplier shall also be included in the equipment submittal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished to the Engineer's field representative one week prior to installation.

B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems mechanical units shall be factory assembled insofar as practical.

C. All Work shall be installed so as to be accessible for operation, maintenance and repair, with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind. Access panels shall be provided as specified and located on the Drawings when Work is built-in or concealed.

D. All work in connection with the manufacture, delivery and erection of the equipment shall be complete so that the equipment is ready for service. In general, piping connections to the equipment and from the equipment will be performed under those respective items, but all interconnecting piping of the machinery, such as minor lines, interconnections between stages, etc., shall be considered as a part of the machinery items. This shall include all anchor bolts, sleeves, supports for equipment, etc. Concrete or structural foundations will be provided under those respective items unless otherwise noted.

E. All accessories for equipment shall be furnished and installed complete. This includes all lubricating, cooling, flushing, priming systems, water sealing systems, etc., such that the equipment may perform satisfactorily in all respects except when the specifications specifically state that this equipment shall be furnished by others.

F. For Pumps and Rotating Equipment, Recheck shaft and coupler alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

3.2 FIELD QUALITY CONTROL

A. All dimensions and clearances affecting the installation of Work shall be verified in the field in relation to established data, to building openings, and to the work of other trades.

B. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the OWNER shall be notified and any changes approved before proceeding with the Work.

C. From investigations, including surveys, made at the site, it is assumed that physical conditions are approximately as indicated on the Drawings.

D. Equipment openings and connections shall be provided with adequate covers at the factory to protect the internals, threads, and flanges and prevent entrance of any foreign matter prior to installation.

E. Shop clean all metal surfaces of dirt, grease, mill scale, contaminants, and prime, finish, or coat in accordance with specifications.

F. Protect motors, electrical equipment, and machinery of all kinds against corrosion, moisture deterioration, mechanical injury, and accumulation of dirt or other foreign matter. Protect all bearings by factory grease packing. Protect all bearings by factory grease packing. Protect all plumbing or heating pipes from freezing during construction.

G. Protect exposed machined surfaces by maintaining a suitable rust preventive compound on these surfaces. Prevent rusting of all unpainted iron and steel surfaces.

H. Handle and ship plate and sheet work so as to prevent permanent deformation or crimps in the materials.

I. Adequately crate, block, anchor, and protect material for shipment. Promptly replace items damaged without expense to OWNER.

J. The CONTRACTOR shall assume full responsibility for all equipment received by him. The CONTRACTOR shall provide adequate protection of all equipment against exposure to the elements. The means of protection shall be subject to the OWNER'S approval. Where facilities are available, and agreement is reached with the OWNER, the CONTRACTOR shall store equipment within the OWNER'S buildings.

3.3 FIELD TESTING OF EQUIPMENT

A. All equipment shall be set, aligned, and assembled in conformance with the manufacturer’s drawings and instructions.

B. Preliminary Field Tests: (Yellow Tag)
   1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall check the equipment for alignment, direction of rotation and that is free from defects.
   2. Contractor shall flush all bearings, gear housings, etc,. in accordance with the manufacturer’s recommendations, to remove any foreign matter accumulated during shipment, storage, or erection. Lubricants shall be added as required by the manufacturer’s instructions.
   3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field test (yellow tag) must be completed before equipment is subjected to the final field test (blue tag).

C. Final Field Test: (Blue Tag)

1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ducting, electrical controls and mechanical operations.
2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operation cycles, and are fee from defects such as overheating, overloading, and undue vibration and noise. Equipment shall be tested for the characteristics as specified for the item.
4. Each pump shall be tested at maximum rated speed for at least four points on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the Engineer and the results recorded. Additional test shall be performed as prescribed in other sections of the Specifications.
5. Pumps with drive motors rated at less than five horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.
6. Recheck shaft and coupler alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
7. Until final tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
8. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
9. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
10. All costs in connection with such tests including all materials, equipment, instruments, labor, etc., shall be borne by the Contractor.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 467116 – GRAVITY BELT THICKENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 40 – Process Integration (Control Panels)

C. General Requirements for Process Equipment – Section 460500

1.2 DESCRIPTION OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install one (1) gravity belt thickeners complete and operational within the Plant Building to thicken a mixture of municipal wastewater treatment plant primary sludge, waste activated sludge, and septage.

1.3 SUBMITTALS

A. Product data: Manufacturer's literature, illustrations, specifications and engineering data.

B. Shop Drawings: Fabrication methods, assembly, accessories, and installation details and wiring diagrams. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages. Control panels detailing interconnecting wiring, terminations, ratings, etc.

C. Product Certificates: Signed by manufacturers of thickeners certifying that all products furnished comply with requirements.

D. Source Quality Control Submittals: Thickener performance test results, results of required control panel shop tests.

E. Site Quality Control Submittals: Written report giving the results of the required field tests and written report of the results of each visit by a manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.

F. Operations and Maintenance Manuals: Submit in accordance with Section 017700.

1.4 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all equipment called for under this Section shall be supplied by a single manufacturer (Thickener Equipment Manufacturer).

B. Manufacturer Qualifications: Thickener Equipment Manufacturer shall have a minimum of ten years' experience producing substantially similar equipment and shall be able to show evidence of at least 20 installations in satisfactory operation for at least 5 years.

C. All components shall be specifically designed for wastewater service and shall be integrated into the overall equipment design by the Thickener Equipment Manufacturer.

1.5 WARRANTY

A. Provide manufacturer's standard warranty in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers (Basis of Bid):
1. Alfa Laval, Inc.
2. Komline Sanderson
3. BDP Industries

2.2 GENERAL CRITERIA

A. The sludge thickening system shall consist of one (1) gravity belt thickeners and all appurtenances. Each gravity belt thickener shall be a complete prefabricated unit consisting of at least a built-in retention tank, a gravity drainage section, a belt alignment and tensioning system, and a belt washing system. Maximum belt width shall be 1.2 meters with the width of the belt area in actual contact with the sludge, known as the effective belt width, shall be 1.0 meters.

B. The thickener units required under this section shall be complete. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed. Ample room for inspection, repairs and adjustment shall be provided.

C. The sludge thickening equipment shall be designed to adequately condition and thicken the sludge so that a thickened sludge cake is produced that easily discharges from the thickening unit without blinding and that may be handled by the pump or conveying equipment.

D. Unless otherwise specified herein, all metal components in contact with polyelectrolyte or sludge shall be of Type 316 stainless steel. All fasteners, washers, pins, anchor bolts, etc. shall be Type 316 stainless steel.

E. All carbon steel plates, shapes, brackets, etc. shall have a minimum thickness of 1/4 inch and be hot-dip galvanized in accordance with ASTM A-123, thickness grade 100 (a minimum thickness of 4 mils). Painted surfaces other than those specified herein will not be considered as an acceptable substitute to this specification.

F. Stainless steel nameplates giving the name of the manufacturer, the thickener serial number and material code shall be attached to each unit.

G. All working parts of the thickeners and motors shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the OWNER may, at any time in the future, obtain replacement and repair parts for those furnished in the original machines.

H. The nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the thickener is operating at any point on its characteristic curve at maximum speed.

I. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA regulations. The noise level of motors, unless otherwise noted, shall not exceed 85 dBA measured 3 meters from the unit under free field conditions while operating on utility power.

J. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards.

2.3 DESIGN CRITERIA

A. Design Criteria: The description of the sludge to be fed to the gravity belt thickeners is as follows:

1. Type of Sludge: Primary Sludge
2. Feed Solids:

	Total
Total Flow to Thickeners (GPD)	120,000
Total Solids to Thickeners (lbs. TSS/day)	30,024
Percent Solids	3

3. Number of Units: One (1) unit.

B. Performance Requirement: Each thickener shall be capable of meeting the following minimum performance criteria:

1. Sludge Throughput 1251 lb./hr.
2. Volume (3% solids) 120,000 gpd
3. Thickened Sludge Concentration 6%
4. Minimum Solids Capture Efficiency 95%

C. The overall dimensions of the gravity belt thickeners shall be such that the installation includes adequate room on one side for the removal of all rollers, as well as a minimum clearance of 3'-0" on all other sides of the units. The minimum clearance requirements

specified herein shall not relieve the contractor from allowing additional clearances for the proper installation, operation, and maintenance of the units including clearance to install and remove the unit(s). Should equipment other than that specified be proposed by the Contractor, the Contractor shall be responsible for any redesign based on the requirements contained herein.

D. Prior to the Design of any structural member, the Contractor and/or the Gravity Belt Thickener manufacturer/supplier should verify all existing dimensions and conditions in addition to coordinating the final equipment dimensions with the Drawings and the approved adjacent Equipment Submittals.

E. The Gravity Belt Thickeners and supports shall be designed to withstand the minimum structural loads shown in Section 460500 per IBC 2021 and Minimum Design Loads and Associated Criteria for Buildings and Other Structures per ASCE 7 for the project site without exceeding the allowable design working stress of the materials involved, including anchors and connections.

2.4 STRUCTURAL MAIN FRAME

A. The structural main frame shall be fabricated of steel members conforming to ASTM Standard Specifications for Steel, Designation A36, into a rigid structure adequately braced to withstand loads with a maximum deflection of 0.010 inches at mid-span.

B. Structural members shall be structural beams, channel, pipe, or tubing with a minimum flange thickness of 3/8" and a minimum web/wall thickness of 1/4". The frame shall have a minimum safety factor under maximum load of 20 times the yield strength of the member. All bolts and fasteners used in the assembly of the structural frame shall have a minimum diameter of no less than 1/2".

C. Maximum load shall be based on the summation of forces applied to the frame from roller mass forces and belt tension forces. The belt tension forces exerted on the frame shall include a minimum loading of 40 pounds per lineal inch of belt width on the rollers, which equates to a belt tension of 20 pounds per lineal inch.

D. The framework shall be of welded and/or bolted construction. All welding shall conform with the American Welding Society Structural Welding Code.

E. The framework shall be prepared and coated after fabrication with hot-dip galvanizing in accordance with ASTM A 123, thickness grade 100 (a minimum thickness of 4 mils) to provide protection against the deteriorating effects of the environment. Zinc flame spray will not be considered an acceptable substitute to this specification. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. Permanent lifting lugs shall be provided as necessary to allow installation and removal of the gravity belt thickener.

F. The construction shall allow easy access and visual contact of all internal components.

2.5 GRAVITY DRAINAGE SECTION

A. The thickening zone of a belt thickener consists of a gravity drainage section and shall be fitted with an inlet distributor to accept sludge from the sludge conditioning system and to evenly distribute the conditioned sludge over the effective width of the moving filter belt.

B. The conditioned sludge shall be contained on the filter belt with Type 316 stainless steel barriers, 14-gauge minimum thickness, and equipped with replaceable seals to prevent leakage.

C. The gravity drainage section shall provide a minimum effective drainage of 44.6 square feet. The effective drainage area shall be defined as the belt width between the sludge containment barriers times the belt length where drainage actually occurs.

D. The filter belt shall be supported in the gravity drainage section by a Type 316 stainless steel grid with a minimum thickness of construction of 10 gauge, fitted with replaceable ultra-high molecular weight high density polyethylene wiper bars spaced at a maximum of 2 1/2" along the length of the zone. The belt support grid shall be a minimum of 2 inches wider than the belt and so designed to reduce belt wear. Wiper bars constructed of fiberglass or other high friction materials, or table rollers, which require maintenance due to coatings and bearings and are unable to remove water clinging to the underside of the belt, shall not be considered an acceptable substitute to this specification.

E. The gravity drainage section shall be furnished with chicanes (plows) to adequately furrow the conditioned sludge to facilitate drainage. The chicanes shall be constructed of high-density polyethylene with hot dipped galvanized cast iron holders and so designed to reduce belt wear. Each row of chicanes shall be provided with a single lifting handle designed to remove the entire row of chicanes at least 6 inches from the belt and out of the sludge flow to facilitate cleaning. Chicanes shall be designed to be individually moved laterally or horizontally. The gravity section will be supplied with a minimum of 8 rows, with a total of 36 chicanes.

F. Mounting brackets and supports rods for the chicanes shall be hot dip galvanized carbon steel or Type 316 stainless steel. All fasteners shall be Type 316 stainless steel.

G. Vacuum assisted or inclined gravity drainage sections, which are subject to flooding, will not be considered an acceptable substitute to this specification.

2.6 ADJUSTABLE RAMP

A. An adjustable ramp shall be provided adjacent to the discharge end of the thickening unit, which causes the thickened sludge to ascend the ramp prior to discharge. The ramp shall be fitted with a replaceable doctor blade as described in Paragraph 2.15. The ramp shall extend across the width of the belt adjacent to the discharge end of the unit and be set at a sufficient height and angle so as to create an optimum backward rolling action of the sludge. The rolling action shall impart a shearing action to the sludge, which further relieves trapped water from between the sludge particles, to enhance and assure optimum thickening.

B. The ramp assembly shall incorporate the following features:

1. The ramp shall be provided with an actuator which includes a manual crank which, when turned, effects the incline of the ramp with respect to the filter belt.
2. The ramp adjustment shall be capable of providing inclination angles of between 10 degrees and 45 degrees relative to the filter belt during operation.
3. The ramp shall be designed so the location of the leading edge of the doctor blade with respect to the belt remains the same regardless of the angle of inclination at which the ramp is set.
4. The ramp assembly shall be capable of being easily and quickly lifted away from the belt and out of the sludge path to facilitate cleaning during operation.
5. The angle of inclination of the ramp shall be capable of being adjusted by one person while the unit is in operation and without the use of tools.

C. All wetted components of the ramp assembly shall be fabricated of Type 316 stainless steel and all other components shall be hot dip galvanized carbon steel.

2.7 ROLLERS

A. All rollers shall be constructed using one-piece forge shafts and end plates. The forged stub shaft unit shall eliminate all welding of the roller shafts in the region of highest stress where the shafts join with the end plates. Welded up constructions of round bar and flat plates that create built in stresses and stress concentrations will not be acceptable. The forged stub shaft unit shall be welded to the roller shell with a machine-applied weld using the submerged arc process. The weld depth shall be equal to the wall thickness of the roller shell. The roller shall be machined so that the total indicated run out of the shell relative to the journals is 0.010 inch maximum. Total surface machining is required to provide a smooth surface for the roller coating.

B. The forged stub shaft unit shall be made of ASTM A572 Grade 50 Type 2 or equal. The roller shells may be ASTM A53 or equal.

C. All solid roller shells shall have a mill spec minimum wall thickness of 1/2 inch. Heavier walls shall be used where required to meet the maximum stress and deflection limits. The roller bearing journals shall be turned to 75 mm to accept direct mounted 75 mm bore bearings. The minimum thickness of the forged flange that forms the end plates shall be one (1) inch.

D. The rollers shall be analyzed using finite element stress analyses. Certified calculations, showing the maximum stress to be less than 1/5 the yield strength of the material and the maximum deflection at mid span to be less than 0.050 inch shall be submitted as set forth in the contract documents. The standard load case for the rollers shall be a distributed load in the belt contact area equivalent to 20 pli belt tension, weight loading and drive torque.

E. The drive roller shall be coated with vulcanized Buna-N rubber to a minimum of 1/4 inch on the belt contact surface and 1/8-inch minimum thickness elsewhere so that no steel surface is exposed.

F. All other rollers shall be coated with 25-mil protective coating of thermoplastic nylon with the following properties:

Properties	Test Method	Value
Hardness, Shore D	ASTM D-2240	77

Specific Gravity	ASTM D-792	1.06 - 1.20
Impact Hardness, RT & 45 F	ASTM D-2794 (Direct Pass)	160 in-lbs
Tensile Strength	ASTM D-638	6000 psi
Elongation	ASTM D-638	15%
Melting Point	ASTM D-789	370 deg. F
Abrasion Resistance (varies with color)	ASTM D-4060 CS17/1000/1000	8 - 18mg wt. loss (Taber abrader)

G. Buna N Rubber Coating shall have the following properties:
1. Tensile Strength, ASTM D-412 – 2500 psi
2. Tear Strength, die C, ASTM D-624 – 250 psi
3. Elongation at break, ASTM D-412 – 160%
4. Hardness, Shore A, ASTM D-676 – 90

H. Other types of protective coatings shall not be acceptable. Rollers shall be coated up to the point of insertion into the bearing block or shall have shafts and heads of Type 316 stainless steel. Carbon steel roller surfaces shall not be exposed to sludge or moisture. The use of rollers constructed entirely of Type 316 stainless steel, in lieu of rollers of carbon steel with protective coatings, shall be considered acceptable under this specification.

2.8 BEARINGS

A. All rollers shall be supported by greaseable, self-aligning roller bearings in sealed, splash proof, horizontal split-case pillow block housings. The bearings shall be attached to the shaft in a direct mount/shrink-fit fashion.

B. All bearings shall have a minimum L_{10} bearing life of 1,000,000 hours, calculated by using ANSI/AFBMA Standard 11-1990. The L_{10} life shall be based on the summation of forces applied to the bearings from belt speed, roller mass forces and belt tension forces. The belt speed used for the L_{10} life calculation shall be 40 meters per minute and the belt tension forces exerted on the rollers shall include a minimum loading of 40 pounds per lineal inch of belt width, which equates to a belt tension of 20 pli. Calculations based on the AFBMA/ISO capacity formula and certified by a registered Professional Engineer in the state of manufacture to show that all bearings comply with the specified requirements for minimum L_{10} bearing life at maximum loading shall be submitted to the Engineer with the submittal package.

C. Bearing housings shall be class 30 cast iron with two mounting bolts and four cap bolts. The housings shall allow the changing of bearings without any changes in the factory alignment of the roller. The roller side of the housings shall be sealed to provide adequate protection from moisture and grime, and shall have an integrally cast water trough which, when shrouded by a shaft-mounted splashguard, will divert waste from the bearing seal area. The outer side of the housing shall be solid, without end caps or filler plugs. The housings shall be cleaned, iron phosphated, and coated with heat applied thermoplastic nylon to a thickness of 8-12 mils. All bolts, nut and washers shall be Type 316 stainless steel.

D. The bearing seal in the pillow block housing shall be of nonmetallic construction. A static sealing arrangement between the seal and the housing shall be a triple rubber seal constructed in a manner that prevents relative rotation between the roller shaft and the seal.

E. Bearing lubrication shall be performed through a monel or Type 316 stainless steel standard grease fitting mounted on the bearing housing. All bearings shall be outboard (externally mounted) and shall be greaseable while the unit is in operation. Lubrication shall not be required more often than once every six months. A dynamic sealing arrangement between the carrier/flinger and the bearing housing shall consist of a primary dynamic contact seal of ozone resistant rubber which shall seal by rotational contact with a machined housing surface. A secondary dynamic seal shall be a labyrinth seal between the carrier/flinger and the bearing housing which utilizes a metallic retaining ring to hold the seal assembly in position within the housing.

2.9 BELT WASH SYSTEM

A. Each gravity belt thickener shall be equipped with a belt wash station for the belt. The station shall consist of a spray pipe fitted with spray nozzles that is contained within a fabricated housing which encapsulates a section of the belt. The housing and nozzle assembly shall be readily removable.

B. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the belt surface. The spray pipe and nozzles shall be of Type 304 or 316 stainless steel construction. Individual nozzles must be replaceable.

C. The housing shall be fabricated from Type 316 stainless steel with a minimum thickness of 14 gauge. The housing shall be sealed around the belt to prevent mist escaping from the enclosure. The seals shall be replaceable without disassembly of the wash station.

D. The spray pipe shall be furnished with a drain valve that has an external hand wheel attached to a stainless-steel cleaning brush located inside the spray pipe. One full turn of the hand wheel shall cause the brush bristles to enter each spray nozzle, dislodge any solid particles that have accumulated, and open the valve and allow the solid particles to be flushed into the drainage system.

E. The belt wash spray tube shall be of the type manufactured by Appleton Manufacturing, Menasha Corporation, Menasha, Wisconsin, the Heinrich Stamm Company, Worms Am Rhein, Germany, or equal.

F. The belt wash station shall be positioned such that the washing is performed after the cake has been discharged from the belt. The belt wash station shall extend over the full width of the filter belt by a minimum of two (2) inches. The belt wash station shall be designed such that it can easily accommodate cleaning from either the clean or dirty side of the belt, or both. The spray tube shall be easily moved between these two positions as required by the demands of the process.

G. The belt wash system shall be suitable for use with non-potable water (maximum 200 mg/l solids) supplied at a minimum pressure of 85 psig and shall be designed to operate on a maximum flow of 20 gpm.

H. The gravity belt thickener shall be provided with a dedicated connection for belt wash water that includes a pressure switch for detection of low water pressure and a motor operated ball valve installed for control of the wash water supply line, both of which shall be mounted on the gravity belt thickener. The belt wash station shall discharge the wash water filtrate to drain line.

2.10 BELT ALIGNMENT SYSTEM

A. The belt shall be provided with an automatic belt alignment system to assure proper alignment of the belt at all times. Belt alignment shall be accomplished using a self-contained system for each unit that does not require an external power source beyond what is required for instrumentation.

B. The belt alignment system shall be provided with sensing devices designed to ride on the edge of the belt to detect position. The sensing device shall include a spring-loaded arm to maintain contact with the belt edge and be fitted with a ceramic plate for abrasion resistance. The arm shall operate a pilot valve, which in turn affects the position of a hydraulic actuator connected to a pivoted belt alignment roller. The pivoting action of the belt alignment roller shall cause this roller to skew from its transverse position to guide the belt centrally along its path.

C. The alignment system shall function as a continuous automatic belt guidance system and shall be an integral part of the thickener. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. The use of electrical servos or systems which utilize devices that maintain alignment by a large snap action-type alternating movement of the alignment roller shall not be considered acceptable to this specification. Rollers for the belt aligning system shall be constructed as specified under Paragraph 2.7. Support bearings for these rollers shall be as specified under Paragraph 2.8.

D. Back-up proximity switches for the belt alignment system shall be provided on the machine with sufficient connections to de-energize all drives and sound an alarm in case of belt over-travel. All piping, valves, fittings, and controls necessary to provide a complete and operational belt alignment system shall be included on the unit(s). A hydraulic unit shall be provided as specified under Paragraph 2.12

2.11 BELT TENSIONING SYSTEM

A. The gravity belt thickener shall be provided with a belt tensioning system. The belt tensioning system shall be hydraulically actuated. The belt shall be furnished with one tension roller. Rollers for the belt tensioning system shall be cylindrical in shape and constructed as specified under Paragraph 2.7. The ends of the shaft shall be supported by bearings, as specified under Paragraph 2.8.

B. Tensioning systems shall have two hydraulic cylinders for the belt with a mechanism to synchronize their position and maintain absolute parallel tension across the entire width of the belt. A proximity sensor for the belt tensioning system shall be provided on the unit with sufficient contacts to de-energize the drive and sound an alarm in case of belt

breakage. The hydraulic cylinders shall be mounted on the edges of the thickener frame for easy access and maintenance.

C. The belt tensioning system shall accommodate a minimum of 2.5% increase in belt length. Manual or electric servo tensioning systems shall not be considered acceptable in this specification.

2.12 HYDRAULIC SYSTEM

A. Each thickener shall be provided with a dedicated hydraulic power system to provide pressurized oil for the steering and tensioning. The unit shall consist of a one-gallon reservoir; variable-displacement pressure compensated hydraulic oil pump and drive motor, hydraulic oil filter, pressure gauges, piping, valves, and cylinders to make a complete operational system.

B. The pump, motor, reservoir, oil filter and valves shall be mounted directly to the thickener frame to minimize excess piping runs, fittings, and hoses. All hydraulic lines shall be properly sized for the pressure and flow of the unit. Pressurized hydraulic lines shall be 316SS tubing and shall be rigidly supported on the structural frame of the thickener. Flexible lines to cylinders, low-pressure connections to the reservoir, etc. shall be hose of the material and construction appropriate to the application. The hydraulic reservoir shall be made of high-density polyethylene (HDPE) and shall be translucent to allow visual inspection of the oil level.

C. The pump motor shall be 1 hp and shall not exceed a noise level of 70 dB. The motor shall be a cast iron TEFC 1,200 rpm, NEMA B design with a C face mounting for the hydraulic pump adapter.

D. Maximum system pressure shall be set equal to the highest pressure required to obtain the desired operating belt tension. The maximum system operating pressure shall be set not to exceed 1,000 psi.

E. Hydraulic system controls shall be grouped for easy access and ease of operation. There shall be means provided to retract the belt tension cylinders for service. The valves, fittings, manifold, and associated parts shall be of non-corroding materials such as FRP, glass filled Nylon or stainless steel.

F. The oil pressure gauge for the belt tension cylinders shall indicate oil pressure in PSI. Low-pressure switch (es) shall be provided to sense the absence of belt tension pressure.

G. Hydraulic cylinders shall have a non-corrosive body and 316 stainless hardware and cylinder rod. The cylinder rod shall be solid stainless with a hardened polished seal contact surface. Chrome or nickel-plated rods are not acceptable.

2.13 BELT DRIVE

A. The drive shall be capable of an A.C. variable speed operation controlled from the thickeners control panel as specified herein.

B. The A.C. variable speed operation shall be controlled through cyclical variation in motor frequency, which is operator set at the variable frequency drive (VFD) in the control panel. Speed reduction shall take place in a helical gear-type reducer. The drive motor shall be of NEMA B design and be furnished with provisions for use on a 230/480-volt, 60 Hz, 3-phase power supply. The motor shall be rated for severe duty with an Insulation Class of F, AGMA class II for 24-hour service, and the service factor shall be 1.14 or greater to ensure that the drive will not fail under even the most extreme operating conditions.

C. The drive roller shall be constructed as specified under Paragraph 2.7 and shall be surfaced with a Buna-N rubber coating (Shore A hardness 90-95) to permit slip-free transmission of driving torque to the belt. The ends of the shafts of each drive roller shall be equipped with a support bearing as specified under Paragraph 2.8. Roller shafts and end plates shall be coated up to the point of insertion into the bearing block.

D. The use of a chain-and-sprocket or belt to transfer power to the drive will not be acceptable.

2.14 FILTER BELT

A. The gravity belt thickener shall incorporate the use of a dewatering belt constructed from seamed fabricated monofilament polyester, wear-resistant plastic materials, or combination monofilament polyester and stainless-steel material. The mesh design shall be selected for optimum dewatering of the sludge to be processed with minimum blinding of the filter bed.

B. Belt selection shall be based on the manufacturer's experience obtained from testing the sludge during start-up of the gravity belt thickeners or at other installations dewatering similar sludges with similar polyelectrolyte conditioning chemicals.

C. The belt and connecting splice shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The splice shall be designed to fail before the belt and shall be constructed of Type 316 stainless steel. Belts shall be designed for ease of replacement with a minimum of thickener down time.

2.15 DOCTOR BLADES

A. Each thickener shall be provided with a doctor blade to assist in the removal of adherent sludge from the filter belt at the discharge end of the gravity zone. The doctor blade shall be mounted so that thickened sludge will be continuously doctored from the belt. The blade shall be at least 1-1/2 inches wider than the belt. The doctor blade shall be ultra-high molecular weight polyethylene and shall be replaceable and designed to wear before the filter belt. The blade shall be affixed to a tensioning mechanism that maintains a force against the surface of the belt. The blade and assembly shall be fabricated with sufficient stiffness so that the blade does not warp, distort, or bow under normal service conditions.

B. The assembly shall be equipped with devices to enable the blade to be quickly released and locked in position away from contact with the belt for cleaning and maintenance. The doctor blade must hold itself no less than two inches away from the belt surface when disengaged and must have an actuating lever or handle on both sides of the thickener.

C. Fiberglass or other high friction blade materials shall not be considered acceptable to this specification.

2.16 DRAINAGE PANS

A. Drainage pans shall be supplied as necessary to contain all filtrate within the gravity belt thickener without splashing and to prevent re-wetting of downstream cake. Filtrate pans shall be constructed of minimum 14-gauge 316 stainless steel suitable for the intended service. Other materials, such as FRP or molded plastic pans, are not considered adequate and shall not be permitted. All drainage piping furnished shall be adequately sized for the intended service and rigidly attached to the frame. Flushing connections or similar provisions shall be provided for easy access during cleaning. Drainage pans shall be located such that the moving belt does not come into contact with the pans under any conditions.

2.17 CONTROL SYSTEM

A. The gravity belt thickener shall be provided with one (1) control panel that will contain the necessary control devices and equipment for controlling the thickening process as described herein. The control panel shall meet the requirements in Section 406716: Process Control Panel & Hardware and Section 406343: Programmable Logic Controllers.

B. IEC rated across-the-line motor starters shall be provided for the wash water pump and hydraulic unit. An Allen Bradley Powerflex style variable frequency drive (VFD) shall be supplied for the belt drive. Short circuit protection for each motor shall be accomplished using thermal magnetic circuit breakers. Individual thermal overload protection shall be provided. A control power transformer shall be included that will provide 120 VAC control power to the system. All logic functions for the system shall be performed by an industrial programmable logic controller (PLC) located in the control panel.

C. Located on the front of the control panel shall be a CONTROL POWER OFF/ON switch. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de-energized. Also located on the control panel shall be an EMERGENCY STOP pushbutton. It shall be an illuminated mushroom head style push-pull operator that when depressed shall immediately de-energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation.

D. System operation: All operation of the thickening units must be accessible from an Operation Interface Unit mounted on the exterior of the enclosure. At a minimum the following additional control pilot devices for each thickener shall be located on the front of the control panel:
   1. HAND/OFF/AUTO MODE selector switch
   2. HAND MODE indicator
   3. AUTO MODE indicator
   4. AUTO START pushbutton
   5. AUTO STOP pushbutton
   6. SYSTEM RESET pushbutton
   7. FAULT indicator

8. ALARM SILENCE pushbutton
9. LAMP TEST pushbutton

E. The panel shall accept the following discrete inputs from others. The signals shall be normally open dry contacts and shall close when the equipment is running.
1. Sludge pump running
2. Polymer pump running
3. Thickened sludge pump running

F. The control panel shall provide the following discrete signals for use by others. The signals shall be dry contacts.
1. Thickener running (N.O. close when running)
2. Thickener fault (N.O. close on alarm)
3. Sludge pump run (N.O. close to run)
4. Polymer pump run (N.O. close to run)
5. Thickened sludge pump run (N.O close to run)

G. The control panel shall accept the following analog signals from others.
1. Sludge pump speed (4-20 mA)
2. Polymer pump speed or (4-20 mA)

H. The control panel shall provide the following analog signals.
1. Sludge pump speed (4-20 mA)
2. Polymer pump speed (4-20 mA)

I. Sequence of Operation
1. Automatic Mode
   a. The thickener may be operated in the automatic mode by placing the HAND/OFF/AUTO selector in the AUTO position. The AUTO MODE indicator will illuminate and the operator will press the AUTO START pushbutton. At this time, the wash water pump, wash water valve and hydraulic pump will be energized, and a belt tensioning time delay will start.
   b. After the belt tensioning timer times out, the belt drive will be energized and a belt pre-wet time delay will start. After the pre-wet timer times out, THICKENER READY will be displayed and, if the THICKENING OFF/ON selector switch is in the ON position, the sludge and polymer pumps will be energized, and the thickened sludge pump shall be enabled. The operator may adjust the belt speed and the flows of sludge and polymer via the Operator Interface Unit touchscreen.
   c. Touching the AUTO STOP button will de-energize the sludge and polymer pumps, disable the thickened sludge pump, display WASHDOWN ON, and start a wash down time delay. After the wash down timer times out, the belt drive, wash water valve, wash water pump, and hydraulic pump will be de-energized.
2. Manual Mode
   a. The manual mode is intended for maintenance and emergency operation only, therefore there shall be no interlocks or time delays in equipment startup.
   b. To operate the thickener in the manual mode, the operator will place the HAND/OFF/AUTO selector in the HAND position. HAND MODE will

be displayed. The operator will start the wash water pump by touching the WASH WATER PUMP START button; start the hydraulic pump by touching the HYDRAULIC PUMP START button. Anytime the wash water pump is running, the wash water valve shall be energized. Touching the BELT DRIVE START button will energize the belt drive. At this time, the operator will start the sludge pump by touching the SLUDGE PUMP START button, start the polymer pump by touching the POLYMER PUMP START button, and start the thickened sludge pump by touching the THICKENED SLUDGE PUMP START button.

c. The system shall be stopped by touching the respective STOP button in the reverse order stated above.

3. Faults

a. When any of the following fault conditions occur, in automatic or manual mode, the appropriate fault indicator will be illuminated or displayed, the alarm horn will sound, and the thickener and all equipment will be de-energized:

1) EMERGENCY STOP
2) LOW WASH WATER PRESSURE (w/time delay)
3) LOW HYDRAULIC PRESSURE (w/time delay)
4) BELT MISALIGNED
5) BELT BROKEN
6) BELT DRIVE FAIL

b. The following fault conditions shall initiate the wash down cycle in the automatic mode (annunciation only in the manual mode):

1) HIGH SLUDGE LEVEL
2) SLUDGE HOPPER HIGH LEVEL

J. Components

1. See Section 406716: Basic Control Panel Material & Methods for minimum control panel requirements.
2. Enclosure: NEMA 4X in accordance with Section 406716: Basic Control Panel Material & Methods.
3. Operator Interface Unit: PanelView Plus with touchscreen in accordance with Section 406716: Basic Control Panel Material & Methods.
4. Motor Starters: Motor starters shall be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 VAC. Motor starters shall be Allen Bradley 100/140M or equal.
5. Speed Controllers: The speed controllers shall be capable of outputting a 4-20ma DC or 0-10v DC set point control signal and accept a 4-20ma DC or 0-10v DC status signal. The controller shall be capable of PID control. The controller shall be Red Lion P48 or equal.
6. Programmable Logic Controller (PLC): The PLC shall be Allen-Bradley MicroLogix as specified in Section 406343: Programmable Logic Controllers.
7. Variable Frequency Drive: The VFD shall be UL listed and shall be Allen Bradley Powerflex 400 style or approved equal.

2.18 EMERGENCY TRIP CORD SYSTEM

A. The thickener shall have an emergency trip cord system for stopping the thickener and directly related equipment. The system shall consist of a switch and pull cable that

encircles all sides of the thickener and is supported on the main frame. Both ends of the cable shall be terminated at the switch on opposite ends of an actuating arm. Pulling the cable at any point shall actuate the switch by rotating the arm and locking it in the tripped position. A separate spring-loaded lever must be depressed to reset the actuating arm to the normal position. The switch shall have a visible signal that it is in the normal or actuated position. The switch shall be wired so that upon actuation, the thickener and directly related devices, such as the sludge feed pump, polymer feed pump, hydraulic pump, wash water system, etc. shall be deactivated or stopped. The switch enclosure shall have at least a Class II, Division 1 & 2, Group E, F, & G rating. The cable shall be mounted and supported so that there are no fixed or binding points along the entire run to the switch.

2.19 SPARE PARTS

A. The following spare parts shall be furnished with each gravity belt thickener:
   1. One filter belt.
   2. Two complete sets of doctor blades.
   3. One of each size and type of bearing complete with bearing seals.
   4. Two complete sets of rubber seals for the gravity zone and belt washbox.
   5. One hydraulic unit oil filter for each thickener supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All installation of the thickening equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces and saddles, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

B. All equipment must be installed in accordance with manufacturer's instructions and approved drawings.

C. Install units on concrete bases and/or grating and secure with anchor bolts in accordance with the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's factory-trained representative, who is specifically knowledgeable in the type of equipment specified herein, shall check and approve the installation prior to operation. Manufacturer's representative shall field test and adjust the equipment to assure that the system operates to the OWNER'S satisfaction.

3.3 START-UP AND FIELD SERVICES

A. Equipment Start Up and Commission shall be in accordance with Section 460500.

B. Upon satisfactory completion equipment startup per Section 460500, a representative of the manufacturer shall be provided to instruct Owner's personnel in the proper operation

and maintenance of the equipment, in accordance with Section 017500. The manufacturer's representative who will be providing the instruction shall have prior operation, maintenance and instructing experience. The representative shall then provide two (2) 8-hour days for operator training exclusive of installation, start-up, and testing support.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 467300 – BIOGAS STORAGE TANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification sets forth the minimum essential characteristics and requirements for the dual membrane air pressurized digester gas holder systems for this project. The Contractor shall install two (2) membrane air pressurized digester gas holder systems. This consists of the replacement of two (2) non-functional systems Tank T-002, and Tank T-003.

B. A third membrane air pressurized digester gas holder system for Tank T-004 may or may not be included for this project based on the overall lowest bid and add alternate pricing. Tank T-004 membrane cover replacement add alternate bid consists of the specifications listed herein and on the contract drawings.

C. Included in this specification are the structural, material, component performance and installation requirements for the membrane style gas holder system.

D. The membrane style gas holder system shall consist of an outer air supported sealing membrane, an inner floating gas membrane, and an air pressurization system. All membranes shall be sealed to the top of ring wall. The gas takeoff line shall be a flexible hose system with a grommet connection to the inner gas membrane.

E. An air chamber shall be formed between the outer air membrane and the floating gas membrane. A gas storage chamber shall be formed between the floating gas membrane and the applicable water surface within the digester.

F. An air hose shall be connected to the outer membrane with a stainless-steel flange connection to the integral air manifold. The air manifold will be constructed out of the same material as the outer membrane and run up to within 5 ft. of the top center of the unit. The manifold will have multiple air openings to allow air to run freely. The air outlet will have the same style manifold to allow air to exit freely.

G. A fan shall be used to pressurize the air chamber. An air pressure control valve in the fan discharge line shall maintain the required air operating pressure, as set by the operator of the system. The force of the air chamber pressure on the gas membrane shall keep the gas operating pressure essentially the same as air pressure until the gas storage chamber is either full or empty.

H. The system shall include controls to provide signals when the system is full or empty. A gas detector shall be provided to monitor the air chamber for the presence of methane.

I. Flame traps with thermal release valves shall be provided in the air supply and air purge ducting to protect against flame propagation from an external source in the event of a gas membrane failure.

1.2 WORK INCLUDED

A. The manufacturer of the gas holder system shall include the following items in his scope of work as applicable for the digester replacement units.
   1. Furnish critical dimensions, loads, and other design requirements including concrete foundation, attachment details, and condensate takeoff sump and piping.
   2. Furnish the foundation mounted items, including:
      a. Air and gas membranes.
      b. Membrane seals and clamp bars.
      c. Flexible gas takeoff hose and grommet connection to inner gas membrane.
   3. Furnish air system components, including:
      a. Air fans with discharge check valves.
      b. Fan inlet filter or screen cage.
      c. Air pressure control valve.
      d. Air inlet and purge line flame traps.
      e. Flexible air takeoff line from membrane to air system ducting.
      f. Gauges at the fan discharge and the pressure control valve
      g. PVC ball valve
   4. Furnish the following gas holder system electrical components.
      a. Air system control panel.
      b. Gas and air pressure transmitters.
      c. Air chamber gas sensor and transmitter
      d. Laser membrane level indicator

1.3 QUALITY ASSURANCE

A. Equipment Manufacturer shall have not less than ten (10) years of experience in the application, design, and manufacture of dual membrane anaerobic digester gas holder systems for wastewater treatment plants.

B. Equipment manufacturer shall provide experienced field service personnel a total of 15 days and 3 trips for the installation checkout and startup of the equipment.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with General Conditions and include the following:

   1. Complete assembly and installation drawings.
   2. Descriptive information on material and equipment furnished.
   3. Location of all appurtenances.

B. Submit O&M manual in accordance with the appropriate sections in these documents.

C. At the engineer's request, submit certification that the Equipment Manufacturer has not less than ten (10) years of experience in the application, design, and manufacture of dual membrane anaerobic digester gas holders for wastewater treatment plants and submit a list of operating installations as evidence of meeting the experience requirement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (Basis of Bid)

A. JDV Equipment Corporation

B. Membrane Systems Europe

2.2 DESIGN REQUIREMENTS

A. Each gas holder system shall be designed for mounting on an existing concrete ringwall (digester replacement units) as indicated on the plans.

B. The minimum usable gas storage volume shall be at least 71,000 cubic feet (TK-002) and 56,000 cubic feet (TK-003 and TK-004).

C. The gas holder system shall be designed to permit digester gas to be stored and maintained automatically at a preset constant operating pressure, as the stored gas volume varies on demand. The system will accommodate gas inflow rates of up to 300 cfm and gas withdrawal rates of up to 300 cfm.

D. The operating pressure for the system shall be adjustable from a minimum of 4" w.c. to a maximum of 12" w.c. without requiring the addition or removal of ballast material. Adjustment shall merely involve setting the pressure control valve relief pressure or the addition/subtraction of weights to a damper valve.

E. The gas holder system shall be designed to allow a pressure increase of up to 1.5" w.c. above the selected operating pressure to allow operation of waste gas and emergency relief systems.

F. The gas holder shall be designed to withstand wind loads of up to 90 mph at the maximum design operating and emergency relief pressure.

G. All components of the system in contact with digester gas shall either be made of materials which are not significantly affected by the normal constituents of this gas or shall be given a protective coating resistant to these constituents.

2.3 MEMBRANE SYSTEM AND APPURTENANCES

A. Air Membrane
1. External membrane shall be constructed of double-sided PVC lined polyester material, UV and microbial resistant, abrasion resistant, made from welded fabric cuts with a short-term tensile strength of 10,000 N/5 cm and a minimum total weight of 1,550 g/m2. Material shall be flame retardant.
2. Membranes shall be specifically designed and manufactured for use as a biogas holder.
3. Membrane cover shall be gray in color..

B. Gas Membranes

1. Gas membrane shall be constructed of double-sided PVC lined polyester material, UV and microbial resistant, abrasion resistant, made from welded fabric cuts with a short-term tensile strength of 4,000 N/5 cm and a minimum total weight of 900 g/m2. Material shall be flame retardant."
2. Membranes shall be specifically designed and manufactured for use as a biogas holder.
3. Membrane cover shall be gray in color."

C. Membrane seals

1. At the tank wall, the membranes shall be sealed by a common seal arrangement, using layers of neoprene on either side of each membrane.
2. The seal shall be held in place on top of the digester wall or tank by appropriately sized aluminum clamping bars.
3. Clamping bar anchors shall be stainless steel adhesive type with stainless steel washers and stainless steel nuts with anti-seize compound applied to all stainless steel hardware.
4. The seal shall be designed to provide a minimum compression load of 30 psi over the entire seal area.

D. Air System Piping
1. All rigid air system piping shall be of sch. 80 PVC pipe
2. Pressure control tubing shall be 1/2" 316 SS

E. Gas System Piping
1. All flexible gas system piping and grommet connections to the inner gas membrane shall supplied by the Manufacturer.

2.4 AIR SYSTEM

A. Blowers
1. Two (2) rotary gas storage blowers one (1) operating, one (1) standby, with all arts of nonsparking construction shall be supplied. Each compressor shall be rated to be in Class 1, Division 1 electrical classification area.
2. Each Rotary blower shall be belt driven by 2 hp, 1760-rpm, explosion-proof (TEFC) motors suitable for 240/480-volt, 3-phase, 60-hertz.
3. The blowers shall be mounted on a common base and furnished complete with sliding base, V-belt drive, V-belt guard, anchor bolts and nuts.

B. Pressure Transmitters
1. Pressure transmitters, with NEMA 4X housings, shall be provided for monitoring air and gas chamber pressures. Transmitters shall be intrinsically safe and rated for the environment located
2. Each transmitter shall provide a 4-20 mA output signal to the PLC in the air system control panel.

C. Pressure Safety Switch
1. One (1) pressure safety switch shall be provided for each Air Blower. The high-pressure protection switch shall be provided on the discharge side to shutdown each Air Blower at 14" w.c.

D. Methane Sensor and Transmitter
1. A methane sensor shall be provided to detect the presence of methane in the air leaving the air chamber. The sensing head and transmitter shall be mounted in the air purge valve by-pass line.
2. The transmitter shall provide a 4-20 mA signal to the PLC in the air system control panel, based on a methane concentration range of 0-100% LEL.

2.5 AIR SYSTEM CONTROL PANEL

A. A complete air system control panel in a NEMA 12 enclosure shall be furnished by the manufacturer of the membrane gas holder system or by the Contractor. A system control panel

with steel supports for each double membrane gasholder will be provided as shown on the contract drawings. The location shall be considered “Hazardous Location, Class I, Division II” as defined by National Electrical Code of the National Board of Fire Underwriters; and all equipment shall be designed accordingly.

B. The panel shall incorporate an Allen Bradley Compact Logix or equal Programmable Logic Controller (PLC) for accomplishing the control logic.

C. An Allen-Bradley Panel View Plus 7 or equal Graphical Operator Interface shall be provided for entering operator selected functions and operating variables, such as fan or purge valve status, timer settings and gas detector alarm levels. The Operator Interface shall also provide a continuous display of the gas and air chamber pressures, plus the concentration of gas (in percent LEL) detected by the gas sensor and transmitter.

D. The PLC shall provide the following minimum control logic.
   1. In the automatic mode, the selected lead fan for the gas holder system shall operate and the purge valve shall be closed. The selected standby fan shall remain idle unless the lead fan overload is tripped. The air chamber shall be inflated to the operating pressure set by the pressure control valve, pressurizing the gas chamber to the same pressure. The purge valve by-pass line solenoid valve shall be open when either fan is running.
   2. Until gas storage is depleted during normal operation, gas pressure will be slightly higher than air pressure due to the added distributed weight of the gas membrane. As gas storage reaches depletion, gas pressure will begin to drop until it is below the air chamber pressure. When gas pressure drops to the same level as air pressure, a "STORAGE EMPTY" signal shall cause an indicator on the face of the panel to begin flashing and the alarm horn to begin pulsing. When gas pressure reaches a level of 0.5" w.c. below the air chamber pressure, the "STORAGE EMPTY" signal shall cause the indicator and alarm horn to be on continuously. The signal shall also stop the fan and open the purge valve to relieve air chamber pressure.
   3. Once the air chamber pressure has been relieved to a level of 0.35" w.c. above gas pressure, the purge valve shall close and a fan restart delay timer, adjustable from 0 - 9 minutes, shall be energized. After the restart delay timer has timed out, the fan shall restart, again pressurizing the air and gas chambers.
   4. When the air chamber has been depleted (maximum gas storage), gas pressure will rise above the air chamber pressure. When gas pressure reaches a point approximately 0.75" w.c. above the air chamber pressure, a "STORAGE FULL" signal shall light an indicator on the face of the control panel.
   5. If at any time the concentration of methane in the air discharge line of the gas holder reaches a preset point of approximately 35% of the lower explosive limit (LEL), the purge valve shall be opened without stopping the fan. A timer shall keep the purge valve open for a period, adjustable up to 99 minutes, allowing the fan to purge the air chamber. If, after this period, the methane concentration has not dropped below the set point, the alarm shall be sounded. If, at any time, the methane concentration reaches 60% of the LEL, the alarm shall also be sounded.

E. Eight sets of isolated contacts shall be provided in the control panel for use by the owner to interlock equipment of his choice with the operation of the membrane gas holder system. The contacts shall be programmable (via the PLC operator interface) to allow them to be energized by the following conditions: Gas Storage Full, Gas Storage Empty, Gas Alarm, Gas Detector Alarm, and Pressure Transmitter Alarms. They may be selected as either "normally open" or

"normally closed" and may be programmed to de-energize either instantaneously or after a period of time (up to 999 minutes) selected by the operator via the operator interface.

F. The electrical control panel shall include provisions for cable, cable routing, and input/output points for interface of the balance of plant instruments supplied by the contractor per the contract drawings. These instruments include but are not limited to gas detectors, VFDs, pressure transducers, and flow meters potentially located in classified hazardous areas. The input/output points for devices located in hazardous areas shall be routed through intrinsically safe barriers provided within the control panel enclosure. Provisions shall be made in the PLC architecture, PLC memory map, and software programming to allot input and output mapping space for the balance of plant instruments. The software shall include logic to initialize communications, scan devices, perform error handling, scale/linearize raw instrument signals, and make available processed data in engineering units for use in the overall process control scheme. Additional IO cards shall be added as required to compensate for additional IO points. All interface wiring and hardware components shall comply with intrinsically safe wiring methods per the NEC and applicable local codes for installation in hazardous locations. See IO List in Appendix XX for additional IO to be integrated into the Biogas Holder Control Panels.

G. The electrical control panel shall include an Uninterruptable Power Supply (UPS) as noted in Section 2.16 of 406716 – Process Control Panels & Hardware. This UPS shall ensure power to the entire panel for a minimum of 4 hours under full load. In the event of power loss to the panel, the plant SCADA system shall be notified by means of either a hardwired digital input to the plant PLC, or a message over ethernet communications.

H. The electrical control panel shall contain a compact ethernet switch and hub. At minimum, the switch shall contain the proper amount of ports to accommodate all RJ45 connectors required as shown on the contract drawings with an additional spare. Reference ‘SECTION 272130’ for details regarding compact switches.

PART 3 - EXECUTION

3.1 INSTALLATION AND TESTING

A. The dual membrane digester gas holder system shall be installed by the Contractor in accordance with the plans and specifications through the use of the Manufacturer’s specialized crews for installation of all components provided by the Manufacturer for the project location.

B. Leak testing of the membrane seals shall be performed by the system installer and witnessed by the owner or their representative.

C. With the gas line closed, the air system fan shall be used to blow air into the gas storage chamber through the test connection provided on the gas takeoff piping. After the unit has been inflated, the test connection shall be capped and the fan connected to the air chamber.

D. Once the gas and air chambers are installed they shall be pressurized to the design operating pressure by installing the correct weights on the air pressure control valve.

E. A soapsuds solution shall then be applied to the membrane seals around the foundation walls. Any area of the seals observed to be leaking shall be resealed.

3.2 MANUALS

A. Five (5) Operation and Maintenance manuals shall be provided. The manuals shall include operating instructions for the system, routine maintenance requirements, and original equipment manufacturer's literature (where applicable) for major components.

3.3. WARRANTY

A. Seller shall furnish its standard warranty against defects in material and workmanship for all equipment, which shall be warranted as provided below. With the limited exception of the Air and Gas Membranes which is subject to the "Membrane Warranty / Membrane Remedy Schedule" as described below, The Seller shall warrant the other equipment, or any components thereof, through the earlier of: (i) eighteen (18) months from delivery of the Equipment or (ii) twelve (12) months from initial operation of the Equipment.

B. Membrane Warranty. The Seller shall furnish its standard Air and Gas Membranes warranty against defects in material and workmanship for a three (3) year period commencing on the earlier of: (a) the date occurring six (6) months after delivery of the membranes or (b) initial operation of Membranes (the "Membrane Warranty Period").
   1. Membrane Remedy Schedule:
      a. 36 Months of Membrane Warranty Period: If repair or replacement of the air or gas Membranes is required during the 36 months of the Membrane Warranty Period, the repair work or replacement membrane will be supplied by Seller at no charge. Installing Contractor or Buyer shall be responsible for removal of the defective membrane and installation of the repaired or replacement membrane and the costs of such removal and installation.

END OF SECTION

Biogas Storage Tanks
30-CP-002
IO List
Wooster Biosolids Upgrade Project
Rev A 3/29/2024

Instrument Tag	Element	Signal Description	Analog/Digital (True) Condition	Signal Type	Range/Off Status	Units/On Status
P-MC-01	P	Mixing Chopper Pump No. 1 RUNNING	RUNNING	DI	NOT RUNNING	RUNNING
P-MC-01	P	Mixing Chopper Pump No. 1 RUN COMMAND	RUN	DO	STOPPED	RUN
P-MC-01	P	Mixing Chopper Pump No. 1 FAULT	FAULT	DI	NORMAL	FAULT
P-MC-01	P	Mixing Chopper Pump No. 1 IN REMOTE	IN REMOTE	DI	IN LOCAL	IN REMOTE
P-MC-01	P	Mixing Chopper Pump No. 1 SPD FDBACK	SPEED FEEDBACK	AI	0 - 100	%
P-MC-01	P	Mixing Chopper Pump No. 1 SPD CMD	SPEED COMMAND	AO	0 - 100	%
P-MC-02	P	Mixing Chopper Pump No. 2 RUNNING	RUNNING	DI	NOT RUNNING	RUNNING
P-MC-02	P	Mixing Chopper Pump No. 2 RUN COMMAND	RUN	DO	STOPPED	RUN
P-MC-02	P	Mixing Chopper Pump No. 2 FAULT	FAULT	DI	NORMAL	FAULT
P-MC-02	P	Mixing Chopper Pump No. 2 IN REMOTE	IN REMOTE	DI	IN LOCAL	IN REMOTE
P-MC-02	P	Mixing Chopper Pump No. 2 SPD FDBACK	SPEED FEEDBACK	AI	0 - 100	%
P-MC-02	P	Mixing Chopper Pump No. 2 SPD CMD	SPEED COMMAND	AO	0 - 100	%
PIT-001	PIT	Feedstock Holding Tank T-001 - Biogas Pressure	Pressure	AI	0-XX	PSI
PIT-3-002	PIT	Digester No. 1 - Biogas Pressure	Pressure	AI	0-XX	PSI
FIT-001	FIT	Feedstock Holding Tank T-001 - Biogas Flow	Flow	AI	0 - XX	GPM
FIT-002	FIT	Digester No. 1 - Biogas Flow	Flow	AI	0 - XX	GPM
AIT-002	DI	Combustible Gas Detector In Digester 2 Tunnel Alarm	Alarm	DI	NORMAL	Alarm
AIT-002	DI	Combustible Gas Detector In Digester 2 Tunnel Alarm	Alarm	DI	NORMAL	Alarm
AIT-002	AIT	Combustible Gas Detector In Digester 2 Tunnel	Gas	AI	0-XX	ppm

Notes:
1. Analog Instrument Ranges To be Verified by Contractor.

Biogas Storage Tanks
30-CP-003
IO List
Wooster Biosolids Upgrade Project
Rev A 3/29/2024

Instrument Tag	Element	Signal Description	Analog/Digital (True) Condition	Signal Type	Range/Off Status	Units/On Status
P-MC-03	P	Mixing Chopper Pump No. 3 RUNNING	RUNNING	DI	NOT RUNNING	RUNNING
P-MC-03	P	Mixing Chopper Pump No. 3 RUN COMMAND	RUN	DO	STOPPED	RUN
P-MC-03	P	Mixing Chopper Pump No. 3 FAULT	FAULT	DI	NORMAL	FAULT
P-MC-03	P	Mixing Chopper Pump No. 3 IN REMOTE	IN REMOTE	DI	IN LOCAL	IN REMOTE
P-MC-03	P	Mixing Chopper Pump No. 3 SPD FDBACK	SPEED FEEDBACK	AI	0 - 100	%
P-MC-03	P	Mixing Chopper Pump No. 3 SPD CMD	SPEED COMMAND	AO	0 - 100	%
P-BL-03	P	Biogas Blower (T-003) RUNNING	RUNNING	DI	NOT RUNNING	RUNNING
P-BL-04	P	Biogas Blower (T-004) RUN COMMAND	RUN	DO	STOPPED	RUN
P-BL-04	P	Biogas Blower (T-004) FAULT	FAULT	DI	NORMAL	FAULT
P-BL-04	P	Biogas Blower (T-004) IN REMOTE	IN REMOTE	DI	IN LOCAL	IN REMOTE
P-BL-04	P	Biogas Blower (T-004) SPD FDBACK	SPEED FEEDBACK	AI	0 - 100	%
P-BL-04	P	Biogas Blower (T-004) SPD CMD	SPEED COMMAND	AO	0 - 100	%
PIT-3-003	PIT	Digester No. 2 - Biogas Pressure	Pressure	AI	0-XX	PSI
FIT-003	FIT	Digester No. 2 - Biogas Flow	Flow	AI	0 - XX	GPM
AIT-003	DI	Combustible Gas Detector In Digester 3 & 4 Tunnel Alarm	Alarm	DI	NORMAL	Alarm
AIT-003	DI	Combustible Gas Detector In Digester 3 & 4 Tunnel Alarm	Alarm	DI	NORMAL	Alarm
AIT-003	AIT	Combustible Gas Detector In Digester 3 & 4 Tunnel	Gas	AI	0-XX	ppm

Notes:
1. Analog Instrument Ranges To be Verified by Contractor.
2. Biogas blower associated IO to be removed from 30-CP-003 if add alternate is awarded.

Biogas Storage Tanks
30-CP-004
IO List
Wooster Biosolids Upgrade Project
Rev A 3/29/2024

Instrument Tag	Element	Signal Description	Analog/Digital (True) Condition	Signal Type	Range/Off Status	Units/On Status
P-MC-04	P	Mixing Chopper Pump No. 4 RUNNING	RUNNING	DI	NOT RUNNING	RUNNING
P-MC-04	P	Mixing Chopper Pump No. 4 RUN COMMAND	RUN	DO	STOPPED	RUN
P-MC-04	P	Mixing Chopper Pump No. 4 FAULT	FAULT	DI	NORMAL	FAULT
P-MC-04	P	Mixing Chopper Pump No. 4 IN REMOTE	IN REMOTE	DI	IN LOCAL	IN REMOTE
P-MC-04	P	Mixing Chopper Pump No. 4 SPD FDBACK	SPEED FEEDBACK	AI	0 - 100	%
P-MC-04	P	Mixing Chopper Pump No. 4 SPD CMD	SPEED COMMAND	AO	0 - 100	%
PIT-3-004	PIT	Digester No. 3 - Biogas Pressure	Pressure	AI	0-XX	PSI
FIT-004	FIT	Digester No. 3 - Biogas Flow	Flow	AI	0 - XX	GPM

Notes:
1. Analog Instrument Ranges To be Verified by Contractor.
2. This panel only to be included in Add Alternate Bid.
3. PIT-3-004 and FIT-004 are to be wired to 30-CP-003 if only Base Bid awarded.