MILLEY'S CREEK WPCP SCREEN REPLACEMENT

PREPARED FOR

WATER WORKS AND SANITARY SEWER BOARD CITY OF MONTGOMERY

VOLUME 1 OF 2
SPECIFICATIONS

For information regarding this project, contact:
NICK FREEMAN, P.E.
4121 CARMICHAEL RD SUITE 400
MONTGOMERY, ALABAMA 36106
(334) 215-9093

Jacobs

Project No. D3571200

JULY 2023

BID DOCUMENTS

THE WATER WORKS AND SANITARY SEWER BOARD

OF THE

CITY OF MONTGOMERY

Montgomery, Alabama

CONTRACT DOCUMENTS

for the

CONSTRUCTION OF

Milley's Creek WPCP Screen Replacement Project

****

CONSISTING OF:

BIDDING REQUIREMENTS

CONTRACT FORMS

CONDITIONS OF THE CONTRACT

SPECIFICATIONS

****

Montgomery, Alabama

Project No: PROJECT # D3571200 Copy No. .....

Milley's Creek WPCP Screen Replacement Project

OWNER

THE WATER WORKS AND
SANITARY SEWER BOARD OF
THE CITY OF MONTGOMERY

2000 Interstate Park Drive
Montgomery, AL 36109

334-206-1600 (Phone # to Board or Board Engineer)

Attn: Jared McLaughlin, P.E.

ENGINEER

JACOBS

4121 Carmichael Road, Suite 400
Montgomery, Alabama 36106

334-215-9093

Attn: Nick Freeman, P.E.

THE WATER WORKS AND SANITARY SEWER BOARD

OF

CITY OF MONTGOMERY

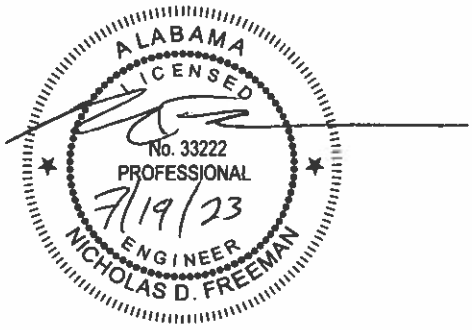
MILLEY'S CREEK WPCP SCREEN REPLACEMENT PROJECT

SIGN AND SEAL SHEET

PART 1 **BIDDING REQUIREMENTS**
PART 2 **CONTRACTING FORMS**
PART 3 **CONDITIONS OF THE CONTRACT**
PART 4 **SPECIFICATIONS**

Nicholas D. Freeman, P.E. No. 33222

DIVISION 1—GENERAL REQUIREMENTS
(the following sections only)
01 11 00, 01 29 00, 01 31 13, 01 31 19, 01 32 00, 01 33 00,
01 43 33, 01 45 16.13, 01 50 00, 01 57 13, 01 57 28, 01 61 00,
01 77 00, 01 78 23, 01 91 14
DIVISION 2—EXISTING CONDITIONS
DIVISION 9—FINISHES
DIVISION 22—PLUMBING
DIVISION 31—EARTHWORK
DIVISION 32—EXTERIOR IMPROVEMENTS
DIVISION 40—PROCESS INTEGRATION
(the following sections only)
40 05 15, 40 05 33, 40 27 00, 40 27 00.01, 40 27 00.06,
40 27 00.10, 40 27 00.14, 40 27 01,40 27 02, 40 42 13,
40 80 01
DIVISION 44—POLLUTION CONTROL EQUIPMENT



THE WATER WORKS AND SANITARY SEWER BOARD

OF

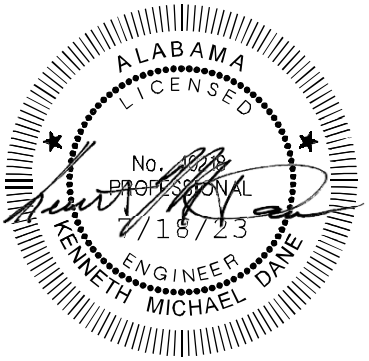
CITY OF MONTGOMERY

MILLEY'S CREEK WPCP SCREEN REPLACEMENT PROJECT

SIGN AND SEAL SHEET

PART 4 SPECIFICATIONS Kenneth Michael Dane, P.E. No. 40218

DIVISION 1—GENERAL REQUIREMENTS
(the following sections only)
01 45 33, 01 88 15
DIVISION 3—CONCRETE
DIVISION 5—METALS



THE WATER WORKS AND SANITARY SEWER BOARD

OF

CITY OF MONTGOMERY

MILLEY'S CREEK WPCP SCREEN REPLACEMENT PROJECT

SIGN AND SEAL SHEET

PART 4 SPECIFICATIONS David Carl Nicholson, P.E. No. 28944

DIVISION 26—ELECTRICAL

David C. Nicholson
CN=David C. Nicholson,
OU=Engineering, O=Jacobs
Engineering Group Inc., L=Dallas,
S=Texas, C=US
2023.07.20 09:47:08-04'00'

THE WATER WORKS AND SANITARY SEWER BOARD

OF

CITY OF MONTGOMERY

MILLEY'S CREEK WPCP SCREEN REPLACEMENT PROJECT

SIGN AND SEAL SHEET

PART 4—SPECIFICATIONS

Christopher Lehman Harris, P.E. No. 32425

DIVISION 40—PROCESS INTEGRATION
(the following sections only)
40 90 00, 40 91 00, 40 99 90

END OF SECTION

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PART 2 CONTRACT FORMS

PART 3 CONDITIONS OF THE CONTRACT

PART 4 SPECIFICATIONS

PART 5 DRAWINGS

Pages

DIVISION 1—GENERAL REQUIREMENTS

DIVISION 2—EXISTING CONDITIONS

DIVISION 3—CONCRETE

DIVISION 4—MASONRY (NOT USED)

Pages

DIVISION 5—METALS

DIVISIONS 6 THROUGH 8 (NOT USED)

DIVISION 9—FINISHES

DIVISIONS 10 THROUGH 21 (NOT USED)

DIVISION 22—PLUMBING

DIVISIONS 23 THROUGH 25 (NOT USED)

DIVISION 26—ELECTRICAL

DIVISION 31—EARTHWORK

END OF SECTION

PART 1 BIDDING REQUIREMENTS

INVITATION TO BID

Sealed proposals for the Milley's Creek WPCP Screen Replacement Project (the "Project"), will be received until **2:00 P.M Central Time,** on **Thursday, August 10, 2023,** by hand delivery or by Federal Express, UPS, or USPS delivery directly to Jared McLaughlin, P.E., The Water Works and Sanitary Sewer Board of the City of Montgomery, Alabama (the "OWNER"), 2000 Interstate Park Drive, Montgomery, AL 36109, and at that time publicly opened and read. A voluntary Pre-bid meeting will be held on **Thursday, July 27, 2023** Information about this Pre-bid meeting will be provided to plan holders. The Project consists of the following major components:

1. Installation of a new spiral screening system.
2. Installation of new piping to reroute influent flows to the new screen and from the new screen to the existing splitter box.
3. Installation of new metal platform to elevate the new screen.

Bids shall be publicly opened at the Owner's offices. For those unable to attend in person a hyperlink will available. The hyperlink will be sent to all plan holders who have purchased bid documents from Jacobs. Other interested parties may obtain hyperlink upon request.

Contract Documents for the Project may be viewed and downloaded by registering with QuestCDN online at www.questcdn.com or physically examined at the office of the Owner's Engineer, Jacobs, at 4121 Carmichael Road, Suite 400, Montgomery, AL 36106. A physical copy of the Contract Documents may be obtained from the Engineer's Office, upon payment of $150 deposit sent to the Owner's Engineer, Attention: Nick Freeman, P.E., Jacobs, at Nicholas.Freeman@jacobs.com or (334) 215-9093.

To view and download digital documents for this project at QuestCDN.com, login or sign up for a free membership within the website's Bidders Tab. Navigate to the digital bidding documents by inputting the Quest Project No. 8594835 on the Project Search page. The digital bidding documents can be viewed for free or downloaded for a non-refundable charge of $22. Any addenda will be posted digitally on the project's website via QuestCDN.com.

The OWNER will only accept Proposals from contractors duly licensed by the Alabama State Licensing Board for General Contractors as required by applicable Alabama law, including without limitation Ala. Code § 34-8-1, *et seq.,* BIDDERS' Alabama General Contractor License Number shall appear on the outside of the envelope containing such bid prior to opening.

THE WATER WORKS AND SANITARY SEWER BOARD
of the City of Montgomery, Alabama

Raymond L. Roton
Chairman

* * * * *

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INSTRUCTIONS TO BIDDERS

1. CONTRACT DOCUMENTS

A. FORMAT

The Contract Documents are divided into parts, divisions, sections, and articles in keeping with accepted industry practice to separate categories of subject matter for convenient reference thereto. Generally, there has been no attempt to divide the Specification sections into work performed by the various building trades, work by separate subcontractors, or work required for separate facilities in the Project.

B. SPECIFICATION LANGUAGE

"Command" type sentences are used in the Contract Documents. These refer to and are directed to the BIDDER.

C. DOCUMENT INTERPRETATION

The Contract Documents governing the work proposed herein consist of the Drawings and all materials bound herewith, including without limitation the Bidding Requirements, Contract Forms, Conditions of the Contract, Specifications, and Drawings. These Contract Documents are intended to provide details reasonably required for the execution of the proposed work.

Any person contemplating the submission of a Proposal shall have thoroughly examined all of the various parts of these Contract Documents and should there be any doubt as to the meaning or intent of said Contract Documents, the BIDDER should request of the OWNER or its ENGINEER (if applicable), in writing (the OWNER or its ENGINEER to have received written request at least 7 days prior to Bid opening), an interpretation thereof. Any interpretation or change in said Contract Documents will be made only in writing in the form of Addenda to the Contract Documents which will be furnished to all BIDDERS receiving a set of the Contract Documents. BIDDERS shall submit with their Proposals, or otherwise indicate receipt of, all Addenda. Neither the OWNER nor its ENGINEER will be responsible for any explanation or interpretations of the Contract Documents not issued in writing by Addendum.

D. DRAWINGS

All plan drawings and detail sheets are included in this document.

E. NUMBER AND GENDER

Whenever the context may require, any pronouns used herein shall include the corresponding masculine, feminine or neuter forms, and the singular form of nouns and pronouns shall include the plural and vice versa.

2. PRE-BID CONFERENCE

A voluntary pre-bid meeting will be held on Thursday, July 27, 2023. The Milley's Creek WPCP will be open to bidders between 9:30 a.m. and 12:00 p.m. to inspect the site. Representatives of the Owner and Engineer will be available to discuss the project. The Engineer will transmit to plan holders of record any addenda or clarifications resulting from the conference the Engineer considers necessary. Oral statements may not be relied upon and will not be binding or legally effective.

3. SCOPE OF PROJECT

A general description of the work to be done is contained in the Invitation to Bid. The scope of the Project is specified in applicable parts of these Contract Documents.

4. LICENSE REQUIREMENTS FOR CONTRACTORS

Attention of each BIDDER is called to the license required by Section 34-8-2, Code of Alabama 1975, and amendments thereto, relating to the licensing of General Contractors. No Bids will be accepted unless submitted by a qualified contractor, duly licensed by the Alabama State Licensing Board for General Contractors. **BIDDER's Alabama General Contractor License Number should be placed on the outside of the envelope in which the Proposal is delivered.**

5. EQUAL EMPLOYMENT OPPORTUNITY (EEO)

If a awarded a contract hereunder, the BIDDER agrees during the life of this Contract not to discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, or creed. The successful BIDDER will include a similar provision in all subcontracts entered into for the performance of this Contract.

6. BIDDER'S UNDERSTANDING

Each BIDDER shall inform himself of the Project site and conditions relating to the execution of the work. The BIDDER may inspect the site notifying OWNER of date and time that BIDDER intends to visit and inspect the site. It is assumed that the BIDDER will make himself thoroughly familiar with all of the Contract Documents and the Project site and conditions. Failure to do so will not relieve the successful BIDDER of his obligation to enter into a Contract and complete the contemplated work in strict accordance with these Contract Documents. The BIDDER's attention is called to other sections of these Contract

Documents in regard to BIDDER's obligations to verify for himself and to his complete satisfaction all information concerning site and subsurface conditions.

Information derived from the Drawings showing location of utilities and structures will not in any way relieve the BIDDER from any risk, or from properly examining the site and making such additional investigations as he may elect, or from properly fulfilling all the terms and conditions of the Contract Documents.

Each BIDDER shall inform himself of, and the BIDDER awarded the Contract shall comply with, all federal, state, and local laws, statutes, and ordinances relative to the regular execution of the work, the employment of labor, protection of public and employee safety and health, all regulations regarding environmental protection, the protection of natural resources, fire protection, burning and non-burning requirements, permits, fees, and similar requirements.

All questions regarding Contract or Project interpretation should be directed to Nick Freeman, P.E. Jacobs, 4121 Carmichael Road, Suite 400, Montgomery, Alabama 36106, Telephone: (334) 215-9093, Email: Nicholas.Freeman@jacobs.com. Questions must be submitted no later than seven (7) days prior to the bid opening date to receive a response.

7. TYPE OF PROPOSAL

LUMP SUM – Lump sum amounts shall be submitted on all items of work required by the Project and specifically set forth in the Proposal. All items required to complete the Project specified or shown on the Drawings, but not included in the Proposal shall be considered incidental to those set forth in the Proposal, and although stated with as much accuracy as possible, is approximate only, and is assumed solely for the basis of calculation upon which the award of a contract hereunder shall be made.

The total amount to be paid the Contractor for the Lump Sum work shall be the amount of the Lump Sum bid as adjusted for additions and deletions resulting from Owner-authorized changes in the Project and/or for Owner-selected equipment/supplier alternates.

The Owner reserves the right to increase or diminish the amount of any item or class of work as it may deem necessary, except that any such increase or decrease in amounts shall not be more than (10%) of the original quantity of such item as shown on the drawings and specifications without a negotiated Change Order, unless otherwise specified in the Supplementary Conditions.

8. PREPARATION OF PROPOSAL

A. GENERAL

All blank spaces in the Proposal form must be completed using BLACK ink, in both words and figures, where required. No changes shall be made in the phraseology of the Proposal forms. Written amounts shall govern in cases of

discrepancy between the amount stated in writing and that stated in figures for any item or class of work. In the event of an error by the BIDDER in calculating the extended total amount for any item of work, such amount will be corrected by extending the written unit price for such item and the BIDDER will be bound by said correction. Also, in the event the total amount of the Bid indicated for the Project (or any defined portion thereof) does not agree with the sum of the extended total amounts, such total will be corrected, and the BIDDER shall be bound by said correction.

Any Proposal may, in the OWNER's sole discretion, be deemed non-responsive or informal which contains omissions, erasures, non-initialed alterations, additions of any kind, conditional bid statements, or in which any of the prices are obviously unbalanced, or which in any manner shall fail to conform to the conditions of the Invitation to Bid.

The BIDDER shall acknowledge receipt of all Addenda in the Proposal. Proposals received without acknowledgment or without the Addenda enclosed may, in the OWNER's sole discretion, be considered non-responsive.

B. SIGNATURE

The BIDDER shall sign his Proposal in the blank space provided therefor. If BIDDER is a corporation, the legal name of the corporation shall be set forth above, together with the signature and title of the officer or officers authorized to sign contracts on behalf of the corporation. If BIDDER is a partnership, the true name of the partnership shall be set forth above, together with the signature of the partner or partners authorized to sign contracts on behalf of the partnership. If BIDDER is a member-managed limited liability company ("LLC"), the legal name of the LLC shall be set forth above, together with the signature of a member authorized to sign contracts on behalf of the LLC. If BIDDER is a manager-managed LLC, the legal name of the LLC shall be set forth above, together with the signature of a manager authorized to sign contracts on behalf of the LLC. **If signature is by an agent, other than an officer of a corporation, a member of a partnership or LLC, or a manager of an LLC, a notarized power-of-attorney or other acceptable evidence of authority must be on file with the OWNER prior to opening of Proposals or submitted with the Proposal, otherwise the Proposal may, in the OWNER's sole discretion, be regarded as not properly authorized and may be considered non-responsive**. **BIDDER shall provide further evidence of authority upon request of OWNER within two business days from the date of such request.**

9. STATE AND LOCAL TAXES

Sales and use taxes shall be included in the prices quoted in the Proposal to the extent applicable. The BIDDER is responsible to inform himself of all applicable State and local

tax laws, fees, assessments, exemptions, and rules that may affect the Proposal and is responsible for compliance therewith.

It is anticipated that certain tax exemptions will apply to this Project. The BIDDER is responsible to inform himself of all applicable tax exemptions, including without limitation the requirements of Ala. Code § 40-9-14.1: Certificates of Exemption to Governmental Entities, Contractors, Etc., for Certain Tax-Exempt Projects. The BIDDER shall further inform himself of Ala. Code § 40-23-4(a)16, Alabama Department of Revenue: Sales and Use Tax Rules, Alabama Administrative Code: Rules of the Alabama Department of Revenue Section 810-6-3.46, and amendments thereto, regarding exemption of water treatment equipment and materials from state and local sales tax. The successful BIDDER is responsible for compliance with all applicable tax exemptions, including without limitation all application and reporting requirements.

10. SUBMISSION OF PROPOSALS

All Proposals must be submitted not later than the time, at the place, and in the manner set forth in the Invitation to Bid. Proposals must be made on the prescribed Proposal forms. BIDDERS may submit their Proposal on the separate pages appended to these Contract Documents. Separate pages for the Bid Bond are also appended for the BIDDER's convenience. Each Proposal must be submitted in a sealed envelope, so marked as to indicate the Project name and the BIDDER’s name without being opened, and the BIDDER’s Alabama General Contractor license number should appear on the outside of the envelope.

11. TELEGRAPHIC OR WRITTEN MODIFICATION OF PROPOSAL

Any BIDDER may modify his Proposal by telegraphic or written communication at any time prior to the scheduled closing time for receipt of bids, provided such communication is received by the OWNER prior to the closing time. The telegraphic or written communication should not reveal the Bid amount but should state only the addition or subtraction or other modification so that the final Bid prices or terms will not be known by the OWNER until the sealed Proposal is opened.

12. WITHDRAWAL OF PROPOSAL

Any Proposal may be withdrawn prior to the scheduled time for the opening of Proposals, either by telegraphic or written request, or in person. Except as provided by law, no Proposal may be withdrawn after the time scheduled for opening of Proposals, unless the time specified in AWARD OF CONTRACT of these INSTRUCTIONS TO BIDDERS shall have elapsed.

13. BID SECURITY

Proposals must be accompanied by cash, a certified check, or cashier's check drawn on a bank in good standing, or a Bid Bond issued by a Surety qualified and authorized to do

business in the State of Alabama and acceptable to the OWNER in an amount not less than five percent (5%) of the total amount of the Bid contained in the Proposal submitted, but in no event more than $10,000.00. This bid security shall be given as a guarantee that the BIDDER will not withdraw his Proposal for a period of 180 days after Bid opening (or such longer period as may be agreed to in writing by the potential lowest responsible and responsive BIDDERS), and that if awarded the Contract, the successful BIDDER will execute the attached Contract, provide all insurance as required, and furnish a properly executed Performance Bond and Payment Bond each for 100 percent of the Contract price within the time specified.

The Attorney-in-Fact (Resident Agent) who executes the bond on behalf of the Surety must attach a notarized copy of his power-of-attorney as evidence of his authority to bind the Surety on the date of execution of the bond. **If the BIDDER elects to furnish a bid bond, he shall use the bid bond form bound herewith. OWNER reserves the right to accept or reject any non-conforming bid bond at OWNER's sole discretion.**

Any cash, certified check or cashier's check provided by the BIDDER as security as set forth above shall be deposited by the OWNER into its account with a bank insured by the Federal Deposit Insurance Corporation. Any interest accrued as a result of said deposit shall be the sole property of the OWNER.

14. RETURN OF BID SECURITY

After the Proposals have been checked, tabulated, and the relation of the Bids established, the OWNER will return the bid securities to all but the three potential lowest responsive BIDDERS. Retained bid securities will be held until the Contract has been finally executed, after which all bid securities, other than BIDDER's bonds and other security that have been forfeited, will be returned to the respective BIDDERS whose Proposals they accompanied.

15. AWARD OF CONTRACT

Within 60 days after the opening of Proposals, the OWNER will accept one of the Proposals, or will act in accordance with BASIS OF AWARD, in these INSTRUCTIONS TO BIDDERS. The Acceptance of the Proposal will be by written notice of award, mailed or delivered to the office designated in the Proposal. In the event of failure of the lowest responsible and responsive qualified BIDDER to sign and return the Contract with acceptable Performance and Payment Bonds and to provide insurance, as prescribed herein, within 14 days of receipt of notice of award, the OWNER may award the Contract to the next lowest responsible and responsive qualified BIDDER. Such award, if made, will be made within 60 days after the opening of Proposals (or such longer period as may be agreed to in writing by the lowest responsible, responsive BIDDERS).

16. BASIS OF AWARD

Work for this Project will be let under one Contract. Award of the Contract will be made on the basis of the lowest Proposal submitted by a responsive, responsible BIDDER meeting the bidding requirements and qualifications set forth in the Contract Documents.

A responsive BIDDER shall be any person, firm, or business entity submitting a Bid for the work contemplated whose Proposal is complete and regular, free of excisions or special conditions that are not accepted by the OWNER, properly executed, and accompanied by all documentation required.

A responsible BIDDER shall be any person, firm, or business entity submitting a Bid for the work contemplated herein who maintains a permanent place of business, is licensed as a General Contractor by the State of Alabama, has adequate equipment and resources to do the work properly and within the time limit that is established, has adequate financial status to meet his obligations contingent to the work, has provided adequate information for the OWNER, in its sole discretion, to determine whether said BIDDER has sufficient prior experience, and has not been party to any action, dispute, litigation, arbitration, or proceeding about which OWNER can reasonably conclude that said BIDDER is not responsible.

If, at the time this Contract is to be awarded, the total Bid of the lowest acceptable Proposal exceeds the funds then estimated by the OWNER as available for the Project, the OWNER may reject all Bids or take such other action as best serves the OWNER's interests.

The OWNER reserves the following rights: (1) to reject all Proposals where the OWNER deems rejection to be in its best interest; (2) to reject any Proposal not in compliance with the Contract Documents; (3) to waive any informalities and irregularities in said Proposals; (4) to postpone award of the Base Bid portion of the Contract, if any, for a period of time which shall not be extended beyond 60 days from the Bid opening without the express written consent of the lowest responsible and responsive BIDDERS; (5) to postpone award of the Additive/Deductive Alternate portions of the Contract, if any, for a period of time which shall not extend beyond 180 days from the Bid opening without the express written consent of the lowest responsible and responsive BIDDERS except as provided in Item "Schedule of Construction" of the Proposal; and (6) to open and consider any Proposal received after the time and date specified herein due to acts of God or other causes beyond the BIDDER's reasonable control and without its fault or negligence should the OWNER determine that the same is in the best interest of the OWNER, provided that such BIDDER uses its best efforts to promptly notify the OWNER of conditions which will result in any such delay and uses its best efforts to avoid or minimize such conditions.

17. EXECUTION OF CONTRACT

The successful BIDDER shall, within 14 days from receiving written notice of award, deliver to the OWNER the properly executed Contract, Performance Bond, Payment Bond, and Certificates of Insurance as required by the OWNER. **The Contract, Performance Bond, Payment Bond, and Certificates of Insurance shall be dated so that each bears the date of the 14th day following the day of their delivery to the OWNER.** Within 14

days after receiving the signed Contract along with acceptable bonds and Certificates of Insurance as required, the OWNER's authorized agent will sign the Contract. Signature by both parties constitutes complete and final execution of the Contract. If not otherwise noted, the effective date of the Contract shall be the day on which the OWNER executes the Contract.

18. PLANS FOR CONSTRUCTION

The successful BIDDER will be furnished three (3) sets of Contract Documents without charge. Any additional copies required will be furnished upon request for production cost.

19. CONTRACT BONDS AND CERTIFICATES OF INSURANCE

A. PERFORMANCE BOND AND PAYMENT BOND

The successful BIDDER shall file with the OWNER, at the time of execution of the Contract, a Performance Bond and a Payment Bond on the forms bound herewith, each in the full amount of the Contract price, as security for the faithful performance of the Contract and the payment of all persons supplying labor and materials for Project, and to cover all guarantees and warranties against defective workmanship or materials, or both, as described in the Contract Documents. The Surety furnishing these bonds shall comply with the requirements stated in AWARD OF CONTRACT of these INSTRUCTIONS TO BIDDERS.

B. POWER OF ATTORNEY

The Attorney-in-Fact (Resident Agent) who executes the Performance Bond and Payment Bond on behalf of the Surety must attach a notarized copy of his power-of-attorney as evidence of his authority to bind the Surety on the date of execution of these bonds. **The Contract, Performance Bond and Payment Bond, and respective powers-of-attorney shall bear the date of the 14th day following the day of their delivery to the OWNER.**

C. CERTIFICATES OF INSURANCE

The successful BIDDER shall file with the OWNER, at the time of execution of the Contract, Certificates of Insurance in full compliance with the provisions of the Contract Documents. The Insurer(s) furnishing the insurance shall comply with the requirements stated in general conditions and supplementary conditions. Upon request by OWNER, the successful BIDDER shall provide full copies of any and all insurance coverages and policies required under the Contract Documents within 5 business days of request.

20. FAILURE TO EXECUTE CONTRACT

The BIDDER who has a Contract awarded to him and who fails to promptly and properly execute the Contract and furnish the required bonds and Certificates of Insurance within

14 days from receiving written notice of award shall forfeit the bid security that accompanied his Bid, and the bid security shall be retained as liquidated damages by the OWNER, and it is agreed that this sum is a fair estimate of the amount of damages the OWNER will sustain in case the BIDDER fails to enter into a Contract and furnish bonds and insurance as hereinbefore provided. Bid security deposited in the form of cash, a certified check, or cashier's check shall be subject to the same requirements as a bid bond.

21. PERFORMANCE OF WORK BY CONTRACTOR

The successful BIDDER shall perform on the sites and with his own organization, at least 50% Performance by Prime of the total amount of the work to be performed under the Contract. If, during the progress of the work hereunder, such contractor requests a reduction of such percentage, and the OWNER determines that such reduction would be in the OWNER's best interest or for the public benefit, the percentage of labor required to be performed by the BIDDER's own organization may be reduced, PROVIDED that prior written approval of any such reduction is obtained from the OWNER.

22. PAYMENTS

Monthly payments for the work performed will be made by the OWNER as specified in the General Conditions, unless otherwise modified in the Supplementary Conditions.

23. TIME OF COMPLETION

The time of completion of the work to be performed under this Contract is the essence of the Contract. Delays and extensions of time may be allowed in accordance with the provisions of the General Conditions. The time allowed for the completion of work is stated in the Proposal.

* * * * * *

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NOTE TO BIDDER: Use BLACK ink for completing this PROPOSAL Form.

PROPOSAL

To: The Water Works and Sanitary Sewer Board
of the City of Montgomery, Alabama

Address: Post Office Box 1631 (2000 Interstate Park Drive, 36109)
Montgomery, Alabama 36102-1631

Project Title: Milley's Creek WPCP Screen Replacement Project.

BIDDER's representative to contact for additional information on this Proposal:

Contact Name: _____

BIDDER's Name:

_____

Telephone: _____

Licensed, Class _____, Alabama Contractor No.: _____

BIDDER'S DECLARATION AND UNDERSTANDING

The undersigned, hereinafter called the BIDDER, declares that the only persons or parties interested in this Proposal are those named herein, that this Proposal is, in all respects, fair and without fraud, that it is made without collusion with any employee or official of the OWNER, and that the Proposal is made without any connection or collusion with any person submitting another Proposal on this Contract.

The BIDDER further declares that he has carefully examined the Contract Documents for the construction of the Project, that he has personally inspected the site and satisfied himself of the Project site and conditions, that he has satisfied himself as to the quantities involved, including materials and equipment, and conditions of work involved, including the fact that the description of the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the said quantities with the detailed requirements of the Contract Documents, and that this Proposal is made according to the provisions and under the terms of the Contract Documents, which are incorporated herein and made a part of this Proposal.

The BIDDER further acknowledges that he has satisfied himself as to the nature and location of the work, the general and local conditions, particularly those bearing upon access to the site; rights-of-way and temporary construction limits; disposal, handling and storage of materials; availability of labor, water, electric power, and roads; and uncertainties of weather, river stages, or similar

physical conditions at the site; the conformation and conditions of the ground; the character of equipment and facilities needed preliminary to and during the prosecution of the work and all other matters which can in any way affect the work or the cost thereof under this Contract.

The BIDDER further specifically acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from his inspection of the site and from reviewing any available records or exploratory work, whether included in these Contract Documents or obtained elsewhere, and that BIDDER has not relied on any representation, opinion, or other information made or provided by the OWNER or its ENGINEER outside of the Contract Documents. **BIDDER understands and agrees that failure to acquaint himself with the physical conditions of the Project site and all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work**.

The BIDDER warrants that, as a result of his examination and investigation of all the aforesaid data, he can perform the work in a good and workmanlike manner, with no less than reasonable care and skill, and to the satisfaction of the OWNER. The OWNER assumes no responsibility for any representations made by any of its officers, employees or agents during or prior to the execution of this Contract, unless (1) such representations are expressly stated in the Contract Documents, and (2) the Contract expressly provides that the responsibility therefor is assumed by the OWNER.

CONTRACT EXECUTION AND BONDS

The BIDDER agrees that if this Proposal is accepted, he will, within 14 days from receiving OWNER's notice of award, sign the Contract in the form annexed hereto, and will at that time, deliver to the OWNER the Performance Bond, Payment Bond, and Certificates of Insurance required herein, and will, to the extent of his Proposal and the requirements of the Contract Documents, furnish all machinery, tools, apparatus, and other means of construction and do the work and furnish all the materials necessary to complete all work as specified or indicated in the Contract Documents.

CERTIFICATES OF INSURANCE

The BIDDER agrees to furnish the OWNER, within 14 days from receiving written Notice of Award, declarations issued by the BIDDER's insurer(s) of all insurance coverage required by the Contract Documents. BIDDER agrees to provide additional evidence of the required insurance coverages upon request of the OWNER.

The BIDDER further agrees that the lump sum or unit price amounts stated herein include specific consideration for the insurance coverages, including contractual liability, which BIDDER is required to provide as specified in the Contract Documents.

SCHEDULE OF CONSTRUCTION

The Project consists of two individual Schedules with different project scopes and substantial completion requirements. Additional information about the scope of each schedule is contained in Specification Section 01 11 00, Summary of Work.

Schedule A – Existing Headworks Bypass Piping
The BIDDER further agrees to begin Schedule A work within 14 days from the Contract start date specified in the OWNER's Notice to Proceed, and to achieve Substantial Completion (as defined in the general conditions) of the work (as defined in the general conditions and described in the Specifications and the Bid Schedule contained in this Proposal) no later than **180 Consecutive Calendar Days** from the Contract start date specified in the OWNER's Notice to Proceed.

Schedule B – Screen Installation
The BIDDER further agrees to begin Schedule B work within 14 days from the start date specified in the OWNER's Schedule B Notice to Proceed, and to achieve Substantial Completion (as defined in the general conditions) of the work (as defined in the general conditions and described in the Specifications and Bid Schedule contained in this Proposal) no later than **360 Consecutive Calendar Days** from the OWNER'S Notice to Proceed.

Total Project Completion
BIDDER agrees to achieve Contract Completion (as defined in the general conditions) in all respects no later than **390 Consecutive Calendar Days** from the Contract start date specified in the OWNER's Notice to Proceed. The BIDDER agrees to base his Proposal and construction schedules on these completion times. Delays and extensions of time may only be allowed in accordance with the provisions of the Contract Documents.

LIQUIDATED DAMAGES AND ADDITIONAL PAYMENTS

In the event the BIDDER is awarded a Contract and shall fail to achieve Substantial Completion and/or Contract Completion within the time limit or extended time limit agreed upon, as more particularly set forth is the Contract Documents, damages shall be paid to the OWNER at the following rates:

1. In the event the BIDDER fails to achieve Schedule A Substantial Completion of the work within **180 Consecutive Calendar Days** (or other such time period as may be agreed upon in writing by the parties following award of the additive alternate portion of the Contract) from the start date specified in the OWNER's Notice to Proceed, liquidated damages shall be paid to the OWNER at the rate of **$500.00 PER DAY** plus any monies paid by the OWNER for engineering, legal and resident observation services, and any fines and all expenses associated with such delays until Substantial Completion is achieved. The BIDDER agrees that $500.00 per day represents a reasonable pre-breach estimate for damages caused by the BIDDER's delay. BIDDER further acknowledges that the payment for the aforementioned daily amount of damages is reasonable and compensates the OWNER for damages that are impossible to accurately estimate. The BIDDER does not consider the payment of damages hereunder to be a penalty, and the BIDDER hereby

waives any claim or defense that payment of damages hereunder is a penalty, or in the nature of a penalty against the BIDDER.

2. In the event the BIDDER fails to achieve Schedule B Substantial Completion of the work within **360 Consecutive Calendar Days** (or other such time period as may be agreed upon in writing by the parties following award of the additive alternate portion of the Contract) from the start date specified in the OWNER's Notice to Proceed, liquidated damages shall be paid to the OWNER at the rate of **$500.00 PER DAY** plus any monies paid by the OWNER for engineering, legal and resident observation services, and any fines and all expenses associated with such delays until Substantial Completion is achieved. The BIDDER agrees that $500.00 per day represents a reasonable pre-breach estimate for damages caused by the BIDDER's delay. BIDDER further acknowledges that the payment for the aforementioned daily amount of damages is reasonable and compensates the OWNER for damages that are impossible to accurately estimate. The BIDDER does not consider the payment of damages hereunder to be a penalty, and the BIDDER hereby waives any claim or defense that payment of damages hereunder is a penalty, or in the nature of a penalty against the BIDDER.

3. In the event the BIDDER fails to achieve Contract Completion in all respects within **390 Consecutive Calendar Days** (or other such time period as may be agreed upon in writing by the parties following award of the additive alternate portion of the Contract) from the start date specified in the OWNER's Notice to Proceed damages shall be paid to the OWNER for any monies paid by the OWNER for engineering, legal, resident observation services, and any fines and all expenses associated with such delays until Contract Completion is achieved in all respects.

ADDENDA

The BIDDER hereby acknowledges that he has received Addenda Nos. _____, _____, _____, _____ to the Drawings, Specifications and/or other Contract Documents (BIDDER shall insert No. of each Addendum received) and agrees that all Addenda issued are hereby made part of the Contract Documents, and the BIDDER further agrees that his Bid includes all impacts resulting from the addition of said Addenda.

SALES AND USE TAXES

The BIDDER agrees that all applicable sales and use taxes are included in the stated bid prices for the work as applicable (refer to the INSTRUCTIONS TO BIDDERS). The BIDDER represents and warrants that BIDDER has informed himself of all applicable tax exemptions and, to the extent applicable, such exemptions are reflected in the bid prices set forth herein.

BASIS OF AWARD

Award of Contract shall be made as set forth in Article 16, Basis of Award, of the Instruction to Bidders, to the lowest responsible, responsive bidder as determined in its sole discretion by the Owner.

LUMP SUM BASE BID

The Bidder hereby proposes to accept as full payment for completion of the Project the amounts computed under the provisions of the Contract Documents and based on the following lump sum amount. The Bidder agrees that the lump sum prices represent a true measure of the labor and materials required to perform the work, including all allowances for overhead and profit for each type of unit of work called for in the Contract Documents. The Lump Sum (LS) shall be shown in both figures and words. In case of discrepancy, the amount in the words shall govern.

PROJECT SCHEDULES

The Bidder is REQUIRED to enter bids for each project schedule listed below. Each project schedule includes different project scope items with different required substantial completion dates which make up the whole of the Project scope. The Owner, in its sole discretion, may consider any Bidder that fails to complete this section nonresponsive, and the Owner reserves the right to do so. The Owner reserves the right to accept or reject any combination of the additive alternate(s) as deemed in its best interest.

Additional information regarding project Schedule A and Schedule B work are found in Specifications and Drawings.

Schedule A

Item	Description	Quantity	Unit	Unit Price in Words	Total
A	Existing Headworks Bypass Piping	1	LS	_____	$_____
TOTAL SCHEDULE A				**$_____**	

Schedule B

Item	Description	Quantity	Unit	Unit Price in Words	Total
B	Screen Installation	1	LS	_____	$_____
TOTAL SCHEDULE A				**$_____**	

The Bidder acknowledges that Lump Sum amount includes the amounts for Schedule A and Schedule B as listed.

The bidder agrees to accept as full payment for the lump sum work proposed under this Project, as herein specified, and as shown on the Drawings the following amount:

_____ DOLLARS

and _____ CENTS $_____

(Amount in words has precedence)

OWNER-SELECTED EQUIPMENT/SUPPLIER

All Owner-Selected Equipment/Supplier items shall be bid according to the following:

The product(s) noted as "(A)" selection for each item of equipment listed in the following Owner-Selected Equipment/Supplier Schedule has been designated by the Owner for use in the Project. Where more than one product is noted as (A), Bidder must circle the item on which the bid is based. The Bidder may indicate substitute equipment/supplier either by circling a named (B), (C), etc., item or by writing in and circling a substitute, and writing in the amount of deduction for the substitute equipment/supplier.

The prior naming of substitute equipment/suppliers is based on a belief that the substitute should be able to furnish "equal" equipment/service as that specified, although it may not be the supplier's standard. Should the circled substitute or circled write-in substitute be disallowed by the Owner as "not equal" or "not desired," then the Bidders shall supply the circled (A) item. If no substitute is indicated, the Bidder must supply the circled (A) item. Should Bidder fail to circle one, or circle more than one, then Bid will be deemed by Owner to be based upon the first-listed equipment/supplier, and Bidder, if awarded the Contract, shall provide same.

The Bidder must supply a base bid for the Owner-Selected Equipment/Supplier items. The bidder may supply a deductive cost from the base bid for at least one of the products noted as (B), (C), (D), etc. This amount will be deducted from the base bid if the Owner in its sole discretion determines that the acceptance of the substitute product is in its own best interest.

Substitute equipment/suppliers will generally be deemed equal provided the "equal" product is equivalent to or better than the product named and described in the Specifications in form, function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made solely by the Owner. The Owner in its sole discretion may determine any substitute "not desired" and reject said substitute.

Additional substitutes will not be considered after receipt of the Bidder's Proposal.

Design of this project is based upon the manufacturer's equipment or product noted as the "A" item in the schedule. Should a Bidder propose furnishing substitute equipment, he shall comply with the following:

In addition to the deduct (if any) offered, the Bidder SHALL REIMBURSE JACOBS (THE "ENGINEER") THROUGH THE OWNER FOR ANY ASSOCIATED REDESIGN AND/OR CONSTRUCTION DRAWINGS by any DIMENSIONAL, MECHANICAL, ELECTRICAL, AND STRUCTURAL CHANGES AND/OR REQUIREMENTS FOR THE SUBSTITUTE'S USE. Bidder, therefore, shall include in his bid for such substitute equipment/supplier mechanical, architectural, structural, electrical, and engineering redesign costs associated with that substitute equipment, material, or supplier. The bid for such substitute equipment/supplier shall also include any paid-up licenses necessary for the use of the equipment if required by the manufacturer.

Reimbursement for engineering redesign shall be based on the Engineer's labor costs times a multiplier of 3.0.

MAJOR EQUIPMENT SUBMITTAL REQUIREMENTS FOR NAMED SUBSTITUTE EQUIPMENT/SUPPLIER. In order that the Owner may determine if the proposed named substitute shall be allowed for the specified and named (A) equipment/supplier, the information below shall be submitted if requested by the Owner for each named substitute entered within 7 days of Owner's request. This request will only be made after receipt of Proposal. This submittal requirement does not apply to unnamed substitute equipment/suppliers, the requirements for which are outlined below.

THIS INFORMATION MUST BE SUBMITTED WITHIN 7 DAYS OF OWNER'S REQUEST:

A. Dimensional and weight information on components and assemblies.

B. Catalog information and cuts.

C. List of requested exceptions to the Contract Documents.

D. Any additional information requested by the Owner.

MAJOR EQUIPMENT SUBMITTAL REQUIREMENTS FOR UNNAMED SUBSTITUTE (WRITE-IN) EQUIPMENT/SUPPLIERS. In order that the Owner may determine if the proposed, unnamed substitute write-in shall be allowed for the specified and named (A) equipment/supplier, the information below shall be SUBMITTED WITH THIS PROPOSAL. This submittal is not required for named substitute equipment/suppliers listed as (B), (C), etc.

THE FOLLOWING MUST BE SUBMITTED WITH THE PROPOSAL:

A. List of any and all exceptions to the Contract Documents.

B. Dimensional and weight information on components and assemblies.

C. Catalog information and cuts.

D. Manufacturer's specifications, including materials description and paint system.

E. Perform data and pump curves, as applicable.

F. Horsepower of all motors supplied.

G. Outside utility requirements for each component, such as water, power, air, etc.

H. Addresses and phone numbers of nearest service center and a listing of the manufacturers or manufacturer's representatives' services available at this location.

I. Addresses and phone numbers for the nearest parts warehouse capable of providing full parts replacement and/or repair service.

J. A list of the three most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in service; include contact name, telephone number, mailing address, and the names of the Engineer, Owner, and Installation Contractor; if three installations do not exist, the list shall include all that do exist, if any.

K. Description of structural, electrical, mechanical, and all other changes or modifications necessary to adapt the equipment or system to the arrangement shown and/or functions described on the Drawings and in the Technical Specifications.

L. Any additional information requested by the Owner.

Section Number	**Description**		**Manufacturer/Supplier**	**Amount of Deduct for Substitute Equipment/Supplier**
44 42 30	Tank Mounted Spiral Screen	(A)	Parkson	XXXXXX
		(A)	Huber Technology, Inc.	XXXXXX

MEASUREMENT AND PAYMENT

Payment for unit price items covers all the labor, materials, equipment, and services necessary to furnish, install and test all of the bid items as designated on the Bid Form and in individual technical Specifications. Any item necessary to complete the installation or identified as required on the Drawings or Specifications but not designated for separate payment, shall be considered incidental to the installation and no separate payment shall be made.

Payment for an individual line item will not be made until all required work associated with the item has been completed and all information has been received and approved, including any required DVD's/Inspection records as required by the Specifications.

EXPERIENCE OF BIDDER

The BIDDER performing the work shall submit a list of at least four (4) projects involving equipment replacement at water or wastewater treatment plants that have achieved substantial completion within the past five (5) years, and where the contract amount of at least one project was greater than five hundred thousand dollars ($500,000).

The BIDDER shall list these previously completed projects similar in scope and nature to that of the OWNER's Project on the following experience form. Projects not completed in strict accordance with plans and specifications of the respective project are not acceptable for purposes of satisfying these minimum experience requirements. In the event that the form does not supply sufficient space to adequately respond, the BIDDER shall include the necessary information by attachment to this Proposal.

OWNER reserves the right to rely solely upon the experience information provided by BIDDER and if such information, as verified by OWNER, does not meet the experience requirements set forth in these Contract Documents, OWNER is not obligated to request additional information from BIDDER and has the right, in OWNER's sole discretion, to deem BIDDER as not responsible. Notwithstanding the foregoing, upon request from the OWNER, the BIDDER shall provide additional written documentation related to the experience of the BIDDER and the individual projects listed below, within two (2) business days of such request.

Experience Table

Project Name	Name of Client and Contact Person	Phone Number	Date of Completion

PERFORMANCE OF WORK BY CONTRACTOR

The BIDDER shall perform at least 50% Performance by Prime of the work with his own forces (refer to INSTRUCTIONS TO BIDDERS section on PERFORMANCE OF WORK BY CONTRACTOR). If, during the progress of work hereunder, the successful BIDDER requests a reduction of such percentage, and the OWNER or Engineer (if applicable) determines that such reduction would be in the OWNER's best interests, the percentage of labor required to be performed by the successful BIDDER's own organization may be reduced, PROVIDED prior written approval of such reduction is obtained by the successful BIDDER from the OWNER.

SUBCONTRACTORS

The BIDDER further certifies that if his Proposal is accepted, the following subcontracting firms or businesses will, subject to approval by the OWNER, be awarded subcontracts for portions of the work listed below. The BIDDER acknowledges and agrees that the OWNER, in its sole and exclusive discretion, can reject the use of any subcontractor by the BIDDER.

_____

Description of Work

_____

Name

_____,_____,_____,_____

Street City State Zip

_____

Description of Work

_____

Name

_____,_____,_____,_____

Street City State Zip

SURETY

If the BIDDER is awarded a construction Contract on this Proposal, the Surety who provides the Performance Bond any Payment Bond will be _____ whose address is:

_____, _____, _____ _____
Street City State Zip

BIDDER

The name of the BIDDER submitting this Proposal is _____

_____ doing business at

_____, _____, _____ _____
Street City State Zip

which is the address to which all communications concerned with this Proposal and with the Contract shall be sent.

The names of the principal officers of the corporation submitting this Proposal, or the members of the limited liability company submitting this Proposal, or partners of the partnership submitting this Proposal, or otherwise of all persons interested in this Proposal as principals, are as follows:

_____ _____

_____ _____

_____ _____

SIGNATURE

If Sole Proprietor

IN WITNESS hereto the undersigned has set his (its) hand and seal this _____ day of _____, ____.

_____L.S.
Signature of BIDDER

Print name: _____

_____
Doing Business As

If Partnership

IN WITNESS hereto the undersigned has set his (its) hand and seal this _____ day of _____, ____.

_____

Name of Partnership

By: _____

Print name: _____

Title: _____

If Corporation

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed and its seal affixed by its duly authorized officers this _____ day of _____, ____.

(SEAL)

_____

Name of Corporation

By: _____

Print name: _____

As its: _____

Attest:

By: _____

Print name: _____

If Limited Liability Company

IN WITNESS WHEREOF the undersigned limited liability company has caused this instrument to be executed and its seal affixed by its duly authorized officers this _____ day of _____, ____.

(SEAL)

_____
Name of Limited Liability Company

By: _____

Print name: _____

As Its: _____

Witness:

By: _____

Print name: _____
__

* * * * * *

BID BOND

BOND NO._____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that _____

_____,

hereinafter called the PRINCIPAL, and _____,

a corporation duly organized under the laws of the State of _____,

having its principal place of business at _____ in the State of

_____ and authorized to do business in the State of Alabama, as SURETY, are held and firmly bound unto The Water Works and Sanitary Sewer Board of the City of Montgomery,

Alabama, hereinafter called the OBLIGEE, in the sum of Five Percent of Bid Amount not to exceed TEN THOUSAND DOLLARS (5% of Bid n/t/e $10,000.00), for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly be these presents.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the PRINCIPAL is herewith submitting his or its Bid Proposal for construction of the Milley's Creek WPCP Screen Replacement Project, said Bid Proposal, by reference thereto, being hereby made a part hereof.

NOW, THEREFORE, if the Bid Proposal submitted by the PRINCIPAL is accepted, and the Contract awarded to the PRINCIPAL, and if the PRINCIPAL shall execute the proposed Contract, shall provide all insurance required, and shall furnish such Performance Bond and Payment Bond and other bonds as required by the Contract Documents within the time fixed by the Contract Documents, then this obligation shall be void. If the PRINCIPAL shall fail to execute the proposed Contract, provide all insurance required, and furnish these bonds, the SURETY hereby agrees to pay the OBLIGEE the said sum as liquidated damages.

This obligation shall not be impaired by any written extension(s) of time for acceptance of the Bid Proposal granted to the OBLIGEE by the PRINCIPAL up to sixty (60) days beyond the time originally allowed for acceptance of the Bid Proposal.

Signed and sealed this _____ day of _____, _____.

_____
PRINCIPAL

(SEAL)

By_____

_____
SURETY

By_____
Attorney-In-Fact

(Attach a notarized copy of Power-of-Attorney evidencing authority of Attorney-in-Fact to bind the Surety on the date of the execution of the Bond.)

* * * * * *

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PART 2 CONTRACT FORMS

CONTRACT

THIS AGREEMENT is made and entered into this _____ day of _____, _____, by and between _____ (the "CONTRACTOR"), and The Water Works and Sanitary Sewer Board of the City of Montgomery, Alabama (the "OWNER") (collectively, CONTRACTOR and OWNER are referred to as the "Parties"):

WITNESSETH:

That the CONTRACTOR, for the consideration hereinafter fully set out, the receipt and sufficiency of which are hereby acknowledged, hereby agrees with the OWNER as follows:

1. The CONTRACTOR shall furnish all the materials and perform all of the work in the construction and completion of **Milley's Creek WPCP Screen Replacement Project** in manner and form as provided by the following enumerated Contract Documents, which are attached hereto and made a part hereof, as if fully contained herein:

   Part 1 – Bidding Requirements
   Part 2 – Contract Forms
   Part 3 – Conditions of the Contract
   Part 4 – Specifications
   Part 5 – Drawings (attached)
   and Addenda.
   (The foregoing is collectively referred to as the "Contract Documents").

2. The CONTRACTOR shall commence the work to be performed under this Agreement within 14 days from the Contract start date specified in the OWNER's Notice to Proceed.

3. The CONTRACTOR shall achieve Schedule A Substantial Completion, as defined in the General Conditions, no later than **180 CONSECUTIVE CALENDAR DAYS** from the Contract start date specified in the OWNER's Notice to Proceed.

   The CONTRACTOR shall achieve Schedule B Substantial Completion, as defined in the General Conditions, no later than **180 CONSECUTIVE CALENDAR DAYS** from the start date specified in the OWNER's Schedule B Notice to Proceed.

   The CONTRACTOR shall achieve Contract Completion, as defined in the General Conditions, within **390 CONSECUTIVE CALENDAR DAYS** from the Contract start date specified in the OWNER's Notice to Proceed.

4. Damages for failing to meet the specified completion times are as stated below:

   A. In the event the CONTRACTOR fails to achieve Schedule A Substantial Completion of the Work **within 180 Consecutive calendar days** from the Contract start date specified in the OWNER's Notice to Proceed, liquidated damages shall be paid to the OWNER at the rate of **$500.00 per day** plus any monies paid by the OWNER for

engineering, legal, and resident observation services, and any fines and all expenses associated with such delays until Substantial Completion is achieved. The CONTRACTOR agrees that $500.00 per day represents a reasonable pre-breach estimate for damages caused the CONTRACTOR's delay. CONTRACTOR further acknowledges that the payment for the aforesaid daily amount of damages is reasonable and compensates the OWNER for damages that are impossible to accurately estimate. The CONTRACTOR does not consider the payment of damages hereunder to be a penalty, and hereby waives any claim or defense that payment of damages hereunder is a penalty, or in the nature of a penalty against the CONTRACTOR.

B. In the event the CONTRACTOR fails to achieve Schedule B Substantial Completion of the Work **within 180 Consecutive calendar days** from the start date specified in the OWNER's Schedule B Notice to Proceed, liquidated damages shall be paid to the OWNER at the rate of **$500.00 per day** plus any monies paid by the OWNER for engineering, legal, and resident observation services, and any fines and all expenses associated with such delays until Substantial Completion is achieved. The CONTRACTOR agrees that $500.00 per day represents a reasonable pre-breach estimate for damages caused the CONTRACTOR's delay. CONTRACTOR further acknowledges that the payment for the aforesaid daily amount of damages is reasonable and compensates the OWNER for damages that are impossible to accurately estimate. The CONTRACTOR does not consider the payment of damages hereunder to be a penalty, and hereby waives any claim or defense that payment of damages hereunder is a penalty, or in the nature of a penalty against the CONTRACTOR.

C. In the event the CONTRACTOR fails to achieve Contract Completion of the work in all respects **within 390 Consecutive calendar days** from the Contract start date specified in the OWNER's Notice to Proceed, damages shall be paid to the OWNER for any monies paid by the OWNER for engineering, legal, and resident observation services, and any fines and all expenses associated with such delays until the work is completed in all respects. The CONTRACTOR agrees that the aforesaid damages represent a reasonable pre-breach estimate for damages caused the CONTRACTOR's delay. CONTRACTOR further acknowledges that the payment for the aforementioned amount of damages is reasonable and compensates the OWNER for damages that are impossible to accurately estimate. The CONTRACTOR does not consider the payment of damages hereunder to be a penalty, and hereby waives any claim or defense that payment of damages hereunder is a penalty, or in the nature of a penalty against the CONTRACTOR.

5. The OWNER hereby agrees to pay the CONTRACTOR for the faithful performance of this Agreement, subject to additions and deductions as provided in the Contract Documents, in lawful money of the United States, the amount of:

_____

_____Dollars ($_____), based on the Proposal contained herein.

6. The CONTRACTOR agrees to use materials, supplies, and products, manufactured, mined, processed, or otherwise produced in the United States or its territories, if the same are available at reasonable and competitive prices and are not contrary to any specification. In the event the CONTRACTOR breaches the agreement to use domestic products, and domestic products are not used, the OWNER may, in its sole discretion, make a downward adjustment in the Contract price equal to any realized savings or benefits to the CONTRACTOR.

7. If steel is required for the Project, the CONTRACTOR agrees to use steel produced within the United States. In the event the CONTRACTOR violates the requirements to use domestic steel, and domestic steel is not used, the OWNER may, in its sole discretion, make a downward adjustment in the Contract price equal to any realized savings or benefits to the CONTRACTOR.

8. Unless otherwise stated in the General Conditions, on or before the 15th day of each calendar month, or within ten (10) calendar days of receipt of an approved pay request, whichever is later, the OWNER shall make partial payments to the CONTRACTOR on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the CONTRACTOR, LESS the retainage provided in the General Conditions, which is to be withheld by the OWNER until all work within a particular part has been performed strictly in accordance with this Agreement and until such work has been accepted by the OWNER. In the event that the OWNER disputes all or any portion of a pay request, then the OWNER shall provide written notice of its dispute, stating the grounds therefore, to the CONTRACTOR within 30 calendar days of receipt of the pay request. The OWNER shall pay any portion of the pay request that is not disputed.

9. Upon submission by the CONTRACTOR of evidence satisfactory to the OWNER that Notice of Completion requirements and all other completion requirements of the General Conditions have been met, and that all payrolls, material bills, and other costs incurred by the CONTRACTOR in connection with the Project have been paid in full, final payment on account of this Agreement shall be made within sixty (60) days from Contract Completion and compliance with all Notice of Completion requirements.

10. It is further mutually agreed between the Parties that if, at any time after the execution of this Agreement and the Surety Bonds hereto attached for its faithful performance and payment, the OWNER, in its sole discretion, shall deem the Surety or Sureties upon such bonds to be unsatisfactory or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the CONTRACTOR shall, at its expense, within five (5) days from the receipt of notice from the OWNER so to do, furnish an additional bond or bonds in such form and amount and with such Surety or Sureties as shall be satisfactory to the OWNER. In such event, no further payment to the CONTRACTOR shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the

OWNER, and if not furnished the CONTRACTOR may be terminated at the option of the OWNER by giving ten (10) days' written notice.

11. No additional work shall be done unless the same shall be duly authorized by appropriate action by the OWNER in writing. No payment for such additional work shall be made unless so authorized.

12. This Agreement shall be governed by the laws of the State of Alabama. In the event that the Parties become engaged in a dispute, the provisions of Articles 74 and 75 of the General Conditions shall apply. Any mediation, arbitration or other proceedings related to or arising under this Contract shall take place in Montgomery, Alabama. In the event that arbitration or litigation is initiated by either Party related to or arising under the subject matter of these Contract Documents, the OWNER shall be entitled to an award of its reasonable attorney fees, court costs, and related legal expenses if CONTRACTOR is found to have breached the Contract Documents, the OWNER is awarded any damages, or the OWNER otherwise prevails in the arbitration or litigation. **The Parties further expressly waive their right to a jury trial.**

13. This Agreement shall be enforceable by the undersigned Parties, exclusively, and is not entered for the benefit of any third party.

14. The CONTRACTOR shall comply with all pertinent sections of the Code of Alabama (1975), including Ala. Code § 39-3-1 and Ala. Code § 39-3-4 as applicable.

15. The contract awarded by this Agreement was let in compliance with Title 39, Code of Alabama (1975), as amended, and all other applicable provisions of law.

16. In compliance with Ala. Code § 41-16-5, the CONTRACTOR hereby certifies that it is not currently engaged in, and will not engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which this state can enjoy open trade.

17. In carrying out any of the provisions hereof, or in exercising any authority granted by this Agreement, there shall be no personal liability upon any public official.

18. This Agreement is intended to be performed in accordance with, and only to the extent permitted by, all applicable laws, ordinances, rules, and regulations. If any provision of the Contract Documents, or the application thereof to any person or circumstance, shall be invalid or unenforceable, for any reason and to any extent, the remainder of the Contract Documents and the application of such provision to other persons or circumstances shall not be affected thereby, but rather shall be enforced to the greatest extent permitted by law.

19. Any modification or amendment of the Contract Documents must be in writing, signed by both Parties, and must expressly indicate an intent to modify the Contract Documents. This Contract shall be binding upon, and inure to the benefit of, the successors and assigns of the Parties hereto; provided, however, that nothing herein shall be construed as

authorizing CONTRACTOR to assign, transfer, or otherwise convey its interest in the Contract.

20. Whenever used and context requires, the singular number shall include the plural, the plural shall include the singular, and the use of any gender shall be applicable to all genders. Where a word or phrase is defined in the Contract Documents, each of its other grammatical forms shall have a corresponding meaning. All section headings or captions in the Contract Documents are for convenience only and shall in no way define, limit, extend, or describe the scope or intent of any provisions of this Agreement. The Parties have participated jointly in the negotiation and drafting of this Agreement. In the event an ambiguity or question of intent or interpretation arises, this Agreement shall be construed as if drafted jointly by the Parties, and no presumption or burden of proof shall arise favoring or disfavoring any Party by virtue of the authorship of this Agreement.

{THE REMAINDER OF THIS PAGE IS LEFT INTENTIONALLY BLANK}

IN WITNESS WHEREOF, the Parties have executed this Agreement, intending to be bound, on the day and date first above written, in three (3) counterparts, each of which shall, without proof or accounting for the other counterpart be deemed an original contract.

CONTRACTOR

If Corporation

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed and its seal affixed by its duly authorized officers this _____ day of _____, ____.

(SEAL)

_____
Name of Corporation

By: _____

Print name: _____

As its: _____

Attest:

By: _____

Print name: _____

As Its: _____

If Limited Liability Company

IN WITNESS WHEREOF the undersigned limited liability company has caused this instrument to be executed and its seal affixed by its duly authorized officers this _____ day of _____, ____.

(SEAL)

_____
Name of Limited Liability Company

By: _____

Print name: _____

As Its: _____

Witness:

By: _____

Print name: _____

As Its: _____

If Sole Proprietor

IN WITNESS hereto the undersigned has set his (its) hand and seal this _____ day of _____, _____.

_____L.S.
Signature of BIDDER

_____
Print name

_____
Doing Business As

If Partnership

IN WITNESS hereto the undersigned has set his (its) hand and seal this _____ day of _____, ____.

_____
BIDDER's Name

By: _____

Print name: _____

Title: _____

OWNER

THE WATER WORKS AND SANITARY SEWER BOARD OF THE CITY OF MONTGOMERY, ALABAMA

ATTEST:

_____ By_____
Secretary Chairman

* * * * * *

PERFORMANCE BOND

BOND NO. _____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that _____

_____,

of _____,

hereinafter called the CONTRACTOR (Principal), and _____

_____, a corporation duly

organized and existing under and by virtue of the laws of the State of _____, hereinafter called the SURETY, and authorized to transact business within the State of Alabama, as SURETY, are held and firmly bound unto The Water Works and Sanitary Sewer Board of the

City of Montgomery, Alabama, as OWNER (Obligee), in the sum of: _____

_____DOLLARS $_____), lawful money of the United States of America, for the payment of which, well and truly be made to the OWNER, the CONTRACTOR and the SURETY bind themselves and each of their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents as follows:

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the CONTRACTOR has executed and entered into a certain Contract hereto attached, with the OWNER, dated _____, _____, for construction of:

Milley's Creek WPCP Screen Replacement Project

NOW, THEREFORE, if the CONTRACTOR shall in all things perform all the terms and conditions of the within and foregoing Contract as provided in the Contract Documents to be by such CONTRACTOR performed, and shall honor all claims for defective work made within the warranty period following completion and acceptance of the work as established in the Contract Documents, and shall pay over, make good and reimburse to the OWNER, all loss or damage which the OWNER may sustain by reason of failure or default on the part of CONTRACTOR, then this obligation shall be void; otherwise it shall be and remain in full force and effect.

PROVIDED, HOWEVER, that the SURETY, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract Documents or to

the work to be performed thereunder, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract Documents.

IN WITNESS WHEREOF, the above parties bounded together have executed this instrument

on this _____ day of _____, _____.

CONTRACTOR

(SEAL) _____

_____ By_____(Seal)
Attest

SURETY

(SEAL)

_____

By_____(Seal)

COUNTERSIGNED:

_____
Resident Agent

_____, _____, _____ _____
Street City State Zip

(Attach notarized copy of Power-of-Attorney evidencing authority of Attorney-in-Fact to bind the Surety on the date of the execution of the Bond)

* * * * * *

CERTIFICATE OF INSURANCE

NAME OF COMPANY: _____

ADDRESS OF COMPANY: _____

_____

NAME OF LOCAL AGENT: _____

ADDRESS OF LOCAL AGENT: _____

_____

This Certificate is issued at the request of The Water Works and Sanitary Sewer Board of the City of Montgomery, Alabama ("OWNER"), for the purpose of certifying to insurance coverage of the following CONTRACTOR who has entered into a Contract with the OWNER for the furnishing of materials and the performance of labor:

NAME OF CONTRACTOR: _____

ADDRESS OF CONTRACTOR: _____

_____

RE: **Milley's Creek WPCP Screen Replacement Project**

The Company acknowledges that it has read and understands the following provisions of the Contract between the OWNER and the CONTRACTOR relating to insurance coverage:

INSURANCE

A. GENERAL

The CONTRACTOR shall provide the insurance coverage designated hereinafter and pay all costs. Insurance shall be with companies which are licensed to do business in Alabama, are approved by the OWNER, and have a Best Rating of B+: VII or better.

Within 14 days from receipt of the Notice of Award, CONTRACTOR shall furnish the OWNER with the signed Certificate of Insurance provided by the OWNER and with the insurer's own Certificate of Insurance showing the type, amount, class of operations covered, effective dates, and date of expiration of policies, and containing substantially the following statement:

"The insurance covered by this certificate shall not be canceled or materially altered, except after 30 days' written notice has been received by the OWNER."

In case of the breach of any provision of this Article, the OWNER, at its option, may take out and maintain, at the expense of the CONTRACTOR, such insurance as the OWNER may deem proper and may deduct the cost of such insurance from any monies which may be due or become due the CONTRACTOR under this Contract.

B. SUBCONTRACTOR'S INSURANCE

The CONTRACTOR shall not allow any Subcontractor to commence work on his subcontract until insurance specified below has been obtained.

C. WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE

The CONTRACTOR shall maintain during the life of this Contract the Statutory amount of Workers' Compensation Insurance, in addition, Employer's Liability Insurance in an amount not less than $100,000 for each occurrence, for all of his employees to be engaged in work on the Project under this Contract. In case any such work is subcontracted, the CONTRACTOR shall require the Subcontractor to provide similar Workers' Compensation and Employer's Liability Insurance for all of the Subcontractor's employees to be engaged in such work. Where work under this Contract includes any water or navigational exposure, coverage shall be included to cover the Federal Longshoremen's and Harborworker's Act and the Federal Jones Act.

D. GENERAL LIABILITY INSURANCE (INCLUDING AUTOMOBILE)

The CONTRACTOR shall maintain during the life of this Contract, Commercial General Liability Insurance written on an occurrence form which includes at least the following coverages: premises/operations liability, products/completed operations liability, independent contractors, contractual liability, personal and advertising injury, explosion, collapse and underground coverage "XC&U" and fire legal liability; and Comprehensive Automobile Liability Insurance, or the equivalent of these coverages. Amount of insurance to be provided shall be as specified in the Supplementary Conditions.

In the event any work under this Contract is performed by a Subcontractor, the CONTRACTOR shall be responsible for any liability directly or indirectly arising out of the work performed by a Subcontractor, to the extent such liability is not covered by the Subcontractor's insurance.

The CONTRACTOR's and any Subcontractor's general liability and automobile liability insurance policies shall endorse the OWNER and its officers, agents, and employees as additional insured for any claims arising out of work performed under this Contract.

E. COMPLETED OPERATIONS COVERAGES

The CONTRACTOR shall maintain completed operations coverage with its certificate on file with the OWNER throughout the warranty period following completion and acceptance of the work as established in the Contract Documents.

F. INSTALLATION FLOATER

The CONTRACTOR shall secure and maintain during the life of this Contract, an Installation Floater in an amount sufficient to cover the property to be installed. Such coverage shall provide for losses to be paid to the CONTRACTOR and the OWNER as their interests may appear, but only if the CONTRACTOR is not in default as to the conditions of the Contract. This coverage may be provided with a maximum of $1,000.00 deductible; however, this shall not relieve the CONTRACTOR of the liability for this amount.

G. OWNER'S PROTECTIVE COVERAGE

The CONTRACTOR shall maintain during the life of this Contract, OWNER's Protective coverage in the name of the OWNER in an amount not less than $1,000,000.

CERTIFICATION

The Company certifies that valid and binding policies have been issued to the CONTRACTOR, with appropriate endorsements naming the OWNER and its representatives or agents as jointly insured where applicable and required, or separate policies issued naming the OWNER as an additional insured, which meet all the requirements of the Contract between the OWNER and the CONTRACTOR, as hereinabove stated.

The Company agrees to give the OWNER thirty (30) days' written notice prior to cancellation of any of the coverage referred to in this Certificate.

NAME OF COMPANY: _____

BY: _____
Authorized Agent of Said Company

* * * * * *

PAYMENT BOND

STATE OF ALABAMA BOND NO. _____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____, as Principal,

and _____, as Surety,

are held and firmly bound unto The Water Works and Sanitary Sewer Board of the City of Montgomery, Alabama (hereinafter called the Obligee), in the penal sum of: _____

_____DOLLARS ($_____),

lawful money of the United States of America, of which sum, well and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has entered into a certain contract with said Obligee, dated

_____, _____, (hereinafter called the "Contract") for construction of:

Milley's Creek WPCP Screen Replacement Project

which Contract and the Specifications for said work shall be deemed a part hereof as fully as if set out herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if said Principal and all subcontractors to whom any portion of work provided for in said Contract is sublet and all assignees of said Principal and of such subcontractors shall promptly make payments to all persons supplying him or them with labor, materials, or supplies for or in the prosecution of the work provided for in such Contract, or in any amendment or extension of or additions to said Contract, and for the payment of reasonable attorney's fees, incurred by the claimant or claimants in suits on each bond, then the above obligations shall be void; otherwise to remain in full force and effect.

PROVIDED, however, that this bond is subject to the following conditions and limitations:

(a) Any person, firm or corporation that has furnished labor, materials, or supplies for or in the prosecution of the work provided for in said Contract shall have a direct right of action against the Principal and Surety on this bond, which right of action shall be asserted in a proceeding instituted in the County in which the work provided for in said Contract is to be performed or in any county in which said Principal and Surety does business. Such right of action shall be asserted in a proceeding instituted in the name of the claimant or claimants for his or their use and benefit against said Principal and Surety or either of them (but not later than one year after the final settlement of said Contract) in which action such claim or claims shall be adjudicated, and judgment rendered thereon.

(b) The Principal and Surety hereby designate and appoint:

_____

(To be filled in by Surety Company)

as the agent of each of them to receive and accept service of process or other pleading issued or filed in any proceeding instituted on this bond and hereby consent that such service shall be the same as personal service on the Principal and/or Surety.

(c) The Surety shall not be liable hereunder for damage or compensation recoverable under any Workmen's Compensation or Employer's Liability Statute.

(d) In no event shall the Surety be liable for a greater sum than the penalty of this bond, or subject to any suit, action or preceding thereon that is instituted later than one year after the final settlement of said Contract.
Executed in three (3) counterparts.

SIGNED, SEALED AND DELIVERED THIS _____ day of _____, _____.

CONTRACTOR

(Seal) _____

By_____

Witness:

_____

_____

SURETY

(Seal) _____

By_____

Countersigned:

_____
Resident Agent

_____, _____, _____
_____
Street City State Zip

(Attach notarized copy of Power-of-Attorney evidencing authority of Attorney-in-Fact to bind the Surety on the date of the execution of the Bond.)

* * * * * *

PART 3 CONDITIONS OF THE CONTRACT

GENERAL CONDITIONS

CONTENTS

This section of the Contract Documents is preprinted. Any modifications to the following Articles required for this project are made in the Supplementary Conditions.

DEFINITIONS

Wherever in the Contract Documents the following terms are used, the intent and meaning shall be interpreted as follows:

1. AS APPROVED

The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the Engineer for conformance with the Contract Document."

2. AS SHOWN, AND AS INDICATED

The words "as shown" and "as indicated" shall be understood to be followed by the words "on the Drawings."

3. BIDDER

The person or persons, partnership, firm, or business entity submitting a Proposal for the work contemplated.

4. CONTRACT DOCUMENTS

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contract, Specifications, Drawings, Addenda, all modifications thereof incorporated into the Contract Documents before their execution, Change Orders, and all other requirements incorporated by specific reference thereto. These form the Contract.

A "modification" is: (1) a written amendment to the Contact signed by both parties; (2) a Change Order; (3) a written interpretation issued by the Engineer pursuant to Article DUTIES AND RESPONSIBILITIES OF THE ENGINEER; or (4) a written order for a minor change in the work issued by the Engineer pursuant to Article CHANGES IN THE WORK.

5. CONTRACTOR

The person or persons, partnership, firm, or corporation who enters into the Contract awarded him by the Owner.

6. CONTRACT COMPLETION

The "Contract Completion" is the date the Owner accepts the entire work as being in compliance with the Contract Documents, or formally waives nonconforming work to the extent of nonconformity, and issues the final payment in accordance with the requirements set forth in Article, NOTICE OF COMPLETION/FINAL PAYMENT of these General Conditions.

7. DAYS

Unless otherwise specifically stated, the term "days" will be understood to mean consecutive calendar days including Saturdays, Sundays, or legal holidays.

8. DEFECTIVE WORK

"Defective Work" is work that (i) is unsatisfactory to the Owner, faulty, or deficient; or (ii) does not conform to the Contract Documents; or (iii) does not meet the requirements of one or more inspections, tests, and/or approvals referred to in the Contract Documents; or (iv) has been damaged prior to the Engineer's recommendation for final payment; or (v) does not conform to generally accepted standards of workmanship.

9. DRAWINGS

The term "Drawings" refers to the official Drawings, profiles, cross sections, elevations, details, and other working drawings and supplementary drawings, or reproductions thereof, signed by the Engineer, which show the location, character, dimensions, and details of the work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

10. ENGINEER

The person or organization identified as such in the Contract Documents. The term "Engineer" means the Engineer and its authorized agents and representatives. If an “Engineer” is not identified in the Contract Documents, references to the “Engineer” herein shall be to the Owner, as applicable. If an “Engineer” is identified, references to “Owner or Engineer” shall be first to Engineer, as applicable.

11. NOTICE

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable state or federal statutes, shall signify a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

12. OR EQUAL

The term "or equal" shall be understood to indicate that the "equal" product is equivalent to or better than the product named in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made by the Owner or Engineer. Such equal products shall not be purchased or installed by the Contractor without written authorization.

13. OWNER

The person, organization, or public body identified as such in the Contract Documents. Wherever in these Documents the word "Owner" appears, it shall be understood to mean The Water Works and Sanitary Sewer Board of the City of Montgomery, whose address is 2000 Interstate Park Dr, Montgomery, AL 36109.

14. PLANS (See DRAWINGS)

15. SPECIFICATIONS

The term "Specifications" refers to those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the work and certain administrative details applicable thereto. Where standard specifications, such as those of ASTM, AASHTO, etc., have been referred to, the applicable portions of such standard specifications shall become a part of these Contract Documents. If referenced specifications conflict with specifications contained herein, the requirements contained herein shall prevail.

The Specifications are written in imperative and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" or "shall meet the requirements of" shall be included by inference where a colon is used within sentences or phrases.

16. NOTICE TO PROCEED

A written notice given by the Owner to the Contractor (with a copy to the Engineer) fixing the date on which the Contract time will commence to run and on which the Contractor shall start to perform its obligation under the Contract Documents. The Notice to Proceed will be given within 30 days following execution of the Contract by the Owner.

17. SUBSTANTIAL COMPLETION

"Substantial completion" shall be that degree of completion of the project or a defined portion of the project, as evidenced by the Owner's or Engineer's written notice of Substantial Completion, sufficient to provide the Owner, at its discretion, the full-time use of the project or defined portion of the project for the purposes for which it was intended. "Substantial Completion" of an operating facility shall be that degree of completion that has provided a minimum of 7 continuous days of successful, trouble-free operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the Owner or Engineer. All equipment contained in the work, plus all other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the substantial completion date.

No portion of the project shall be deemed substantially complete until it has been functional for seven consecutive days in a manner acceptable to the Owner and Engineer and with all systems fully operational. In addition, no portion of the project shall be deemed substantially complete for which foreseeable work to repair or complete such portion or other portions of the work will cause disruptions or shutdowns of the treatment process or make operation impossible, impractical, or inefficient.

18. WORK

The word "work" within these Contract Documents shall include all material, labor, construction, services, tools, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Project in accordance with the Contract Documents, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure. As used herein, "provide" shall be understood to mean "furnish and install, complete in-place".

CONTRACT DOCUMENTS

19. INTENT OF CONTRACT DOCUMENTS

The Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. The intent of the Documents is to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any work, materials, or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for. When words, which have a well-known technical or trade meaning are

used to describe work, materials, or equipment, such words shall be interpreted in accordance with that meaning.

Reference to standard specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws, or regulations in effect on the first published date of the Invitation to Bid, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of Owner, Contractor, or Engineer, or any of their consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Engineer, or any of Engineer's consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the provisions of Article LIMITATIONS ON ENGINEER'S RESPONSIBILITIES.

20. DISCREPANCIES AND OMISSIONS

Any discrepancies or omissions found in the Contract Documents shall be reported to the Owner and Engineer immediately. The Owner or Engineer will clarify discrepancies or omissions, in writing, within a reasonable time. In resolving inconsistencies among two or more sections of the Contract Documents, precedence shall be given in the following order:

A. CONTRACT
B. PROPOSAL
C. SUPPLEMENTARY CONDITIONS
D. INVITATION TO BID
E. INSTRUCTIONS TO BIDDERS

F. GENERAL CONDITIONS
G. SPECIFICATIONS
H. DRAWINGS

Addenda shall take precedence over all sections referenced therein. Figure dimensions on Drawings shall take precedence over scale dimensions. Detailed Drawings shall take precedence over general Drawings.

21. CHANGES IN THE WORK

The Owner, without notice to the Sureties and without invalidating the Contract, may order changes in the work within the general scope of the Contract by altering, adding to, or deducting from the work, the Contract being adjusted accordingly. All such work shall be executed under the conditions of the original Contract, except as specifically adjusted at the time of ordering such change.

In giving instructions, the Owner or Engineer may order minor changes in the work not involving extra cost and not inconsistent with the purposes of the project, but otherwise, except in an emergency endangering life or property, additions or deductions from the work shall be performed only in pursuance of an approved Change Order from the Owner and Engineer.

If the work is reduced by alterations, such action shall not constitute a claim for damages based on loss of anticipated profits.

22. EXAMINATION AND VERIFICATION OF CONTRACT DOCUMENTS

The Contractor shall thoroughly examine and become familiar with all of the various parts of these Contract Documents and determine the nature and location of the work, the general and local conditions, and all other matters which can in any way affect the work under this Contract. Failure to make an examination necessary for this determination shall not release the Contractor from the obligations of this Contract. No verbal agreement or conversation with any officer, agent, or employee of the Owner, or with the Engineer either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

23. DOCUMENTS TO BE KEPT ON THE JOBSITE

The Contractor shall keep one copy of the Contract Documents on the jobsite, in good order, available to the Owner and Engineer and to its representatives.

The Contractor shall maintain on a daily basis at the jobsite, and make available to the Owner and Engineer on request, one current record set of the Drawings which have been accurately marked to indicate all modifications in the completed work that differ from the design information shown on the Drawings. Upon substantial completion of the work, the Contractor shall give the Owner and Engineer one complete set of these marked up record Drawings.

24.ADDITIONAL CONTRACT DOCUMENTS

Copies of Contract Documents or Drawings may be obtained on request from the Owner or Engineer and by paying the actual cost of reproducing the Contract Docu-

ments or Drawings.

25. OWNERSHIP OF CONTRACT DOCUMENTS

All portions of the Contract Documents, and copies thereof furnished by the Owner or Engineer, are the instruments of service for this project. They are not to be used on other work and are to be returned to the Owner or Engineer on request at the completion of the work. Any reuse of these materials without specific written verification or adaptation by the Owner or Engineer will be at the risk of the user and without liability or legal expense to the Owner or Engineer. Such user shall hold the Owner and Engineer harmless from any and all damages, including reasonable attorneys' fees, and from any and all claims arising from any such reuse. Any such verification and adaptation shall entitle the Owner or Engineer to further compensation at rates to be agreed upon by the user and the Owner or Engineer.

THE ENGINEER

26. AUTHORITY OF THE ENGINEER

The Engineer, if applicable, will be the Owner's representative during the construction period. Its authority and responsibility will be limited to the provisions set forth in these Contract Documents. The Engineer will have the authority to reject work which does not conform to the Contract Documents. However, neither the Engineer's authority to act under this provision, nor any decision made by him in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, their respective Sureties, any of their agents or employees, or any other person performing any of the work.

27. DUTIES AND RESPONSIBILITIES OF THE ENGINEER

The Engineer, if applicable, will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the work and to determine, in general, if the work is proceeding in accordance with the intent of the Contract Documents. He will not make comprehensive or continuous review or observation to check quality or quantity of the work, and he will not be responsible for construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the work. One or more onsite project representatives may be assigned by the Engineer to observe the work. It is understood that such project representatives shall have the authority to issue notice of nonconformance and make decisions within the limitations of the authority of the Engineer. The Contractor shall cooperate fully and furnish all reasonable assistance required by the Engineer or its project representatives for proper observation of the work.

Neither visits and observations made by the Engineer nor attendance and observations by its onsite project representatives shall relieve the Contractor of its obligations to conduct comprehensive inspections of the work sufficient to ensure conformance with the intent of the Contract Documents, to furnish materials and perform acceptable work, and to provide adequate safety precautions, in conformance with the intent of the Contract Documents. Nor shall any such visits, attendance, or observations by the Engineer or its assigned onsite project representatives relieve the Contractor of total responsibility for all construction, means, methods techniques, sequences, and procedures necessary for coordinating and completing all portions of the work in conformance with the intent of the Contract Documents and for all safety precautions and programs in connection with the work.

The Engineer will make recommendations to the Owner, in writing, on all claims of the Owner or the Contractor arising from interpretation or execution of the Contract Documents. Such recommendations will be of factual and/or technical nature, and will not include the legal interpretation of the Contract Documents. Any necessary legal interpretation of the Contract Document will be made by the Owner.

Such recommendation shall be necessary before the Contractor can receive additional money under the terms of the Contract. Changes in work ordered by the Engineer shall be made in compliance with Article CHANGES IN THE WORK.

28. LIMITATIONS ON ENGINEER'S RESPONSIBILITIES

Engineer, if applicable, will not be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, and Engineer will not be responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.

Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any supplier, or of any other person or organization performing or furnishing any of the work.

Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved," or terms of like effect or import are used, or

the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory," or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of Engineer as to the work, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the provisions of this Article.

29. REJECTED WORK

Any defective work or nonconforming materials or equipment that may be discovered at any time prior to expiration of the warranty period shall be removed and replaced by work which shall conform to the provisions of the Contract Documents. Any material condemned or rejected shall be removed at once from the project site.

Failure on the part of the Owner or Engineer to condemn or reject bad or inferior work or to note nonconforming materials or equipment on Contractor submittals shall not be construed to imply acceptance of such work. The Owner shall reserve and retain all of its rights and remedies at law against the Contractor and its Surety for correction of any and all latent defects discovered after the warranty period.

30. LINES AND GRADES

Lines and grades shall be established as provided in the Supplementary Conditions. All stakes, marks, and other reference information shall be carefully preserved by the Contractor, and in case of their careless or unnecessary destruction or removal by him or its employees, such stakes, marks, and other information shall be replaced at the Contractor's expense.

31. SUBMITTALS

Technical submittals will be submitted as described in Section SUBMITTALS. The specific information requirements for particular technical submittals are set forth in the Specifications.

The review of such technical submittals by the Owner or Engineer shall not relieve the Contractor from responsibility for correctness of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the technical submittals and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the technical submittals. When the Contractor does call such deviations to the attention of the Engineer, the Contractor shall state in its letter whether or not such deviations involve any deduction or extra cost adjustment.

The Engineer's review will be only for conformance with the design concept of the project and compliance with the Contract Documents and shall not extend to means, methods, techniques, sequences, or procedures of construction (except where same is specifically indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions.
Where a technical submittal is required by the Specifications, any related work performed prior to the Engineer's having reviewed an acceptable technical submittal shall be the sole expense and responsibility of the Contractor.

Should the Contractor fail to submit acceptable shop drawings on the second submittal, the copies will be returned to him. The Contractor shall be solely responsible for reimbursing the Engineer for the cost of the Engineer's time to review subsequent submittals on the unacceptable item.

Reimbursement shall be based on the Engineer's salary cost times a multiplier of 2.15 plus any direct nonlabor expenses such as travel or per diem. Salary costs are defined as raw labor costs plus salary overheads that are defined as a percentage of wages or salaries of employees working and premiums measured by or applicable at the time of performance to such wages or salaries such as, but not limited to, Workers Compensation, insurance, Social Security, state and federal unemployment insurance, salary continuation insurance, pension plan costs, and prorated allowances for vacation, sick pay, and holiday pay.

32. DETAIL DRAWINGS AND INSTRUCTIONS

The Owner or Engineer will furnish, with reasonable promptness, additional instructions by means of Drawings or otherwise, if, in the Owner’s or Engineer's opinion, such are required for the proper execution of the work. All such Drawings and instructions will be consistent with the Contract Documents, true developments thereof, and reasonably inferable therefrom.

<u>THE CONTRACTOR AND ITS EMPLOYEES</u>

33. INDEPENDENT CONTRACTOR

The Contractor shall independently perform all work under this Contract and shall not be considered as an agent of the Owner or of the Engineer, nor shall the Contractor's Subcontractors or employees be subagents of the Owner or of the Engineer.

The Contractor shall not assign, transfer, convey, or otherwise dispose of this Contract or any of the proceeds thereunder unless written consent of the Owner has been obtained. No right under this Contract or claim for any proceeds due or to become due hereunder shall be asserted against the Owner, or persons acting for the Owner, by reason of any so-called assignment, transfer, or conveyance of this Contract or any part thereof unless such assignment, transfer, or conveyance has been authorized by the written consent of the Owner. The instrument of assignment, transfer, or conveyance shall contain a clause subordinating the claim of the assignee, transferee, or conveyee to all prior liens for services rendered or materials supplied for the execution of the work.

34. SUBCONTRACTING

Unless modified in the Supplementary Conditions, within 10 days after the execution of the Contract, the Contractor shall submit to the Owner or Engineer the names of all Subcontractors proposed for the work, including the names of any Subcontractors that were submitted with the Proposal. The Contractor shall not employ any Subcontractors to which the Owner in its sole and absolute discretion objects.

The Contractor is as fully responsible to the Owner for the acts and omissions of its 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.

Nothing contained in the Contract Documents shall create or construed to create any contractual relationship between any Subcontractor and the Owner or Engineer.

35. INSURANCE AND LIABILITY

A. GENERAL

The Contractor shall provide the insurance coverage designated hereinafter and pay all costs throughout the term of this Contract. Insurance shall be with companies which are licensed to do business in Alabama, are approved by the Owner, and have a Best Rating of B+:VII or better.

Within 14 days from receipt of the Notice of Award, Contractor shall furnish the Owner with the signed Certificate of Insurance provided by the Owner and with the insurer's own Certificate of Insurance showing the type, amount, class of operations covered, effective dates, and date of expiration of policies, and containing substantially the following statement:

The insurance covered by this certificate shall not be canceled or materially altered, except after 30 days' written notice has been received by the Owner.

In case of the breach of any provision of this Article, the Owner, at its option, may take out and maintain, at the expense of the Contractor, such insurance as the Owner may deem proper and may deduct the cost of such

insurance from any monies which may be due or become due the Contractor under this Contract.

B. SUBCONTRACTOR'S INSURANCE

The Contractor shall not allow any Subcontractor to commence work on its subcontract until insurance specified below has been obtained.

C. WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE

The Contractor shall maintain during the life of this Contract the statutory amount of Workers' Compensation Insurance, in addition, Employer's Liability Insurance in an amount not less than $100,000 for each occurrence, for all of its employees to be engaged in work on the project under this Contract. In case any such work is subcontracted, the Contractor shall require the Subcontractor to provide similar Workers' Compensation and Employer's Liability Insurance for all of the Subcontractor's employees to be engaged in such work. Where work under this Contract includes any water or navigational exposure, coverage shall be included to cover the Federal Longshoremen's and Harborworker's Act and the Federal Jones Act.

D. GENERAL LIABILITY INSURANCE (INCLUDING AUTOMOBILE)

The Contractor shall maintain during the life of this Contract Commercial General Liability Insurance written on an occurrence form which includes at least the following coverages: premises/operations liability, products/completed operations liability, independent contractors, contractual liability, personal and advertising injury, explosion, collapse and underground coverage "X, C, and U" and fire legal liability; and

Comprehensive Automobile Liability Insurance, or the equivalent of these coverages. Amount of insurance to be provided shall be as specified in the Supplementary Conditions.

In the event any work under this Contract is performed by a Subcontractor, the Contractor shall be responsible for any liability directly or indirectly arising out of the work performed by a Subcontractor, to the extent such liability is not covered by the Subcontractor's insurance. The Contractor's and any Subcontractor's general liability and automobile liability insurance policies shall endorse the Owner and Engineer, their officers, agents, and employees as additional insureds for any claim arising out of work performed under this Contract.

E. COMPLETED OPERATIONS COVERAGES

The Contractor shall maintain completed operations coverage with its certificate on file with the Owner throughout the warranty period following completion and acceptance of the work as established in the Contract Documents.

F. BUILDERS RISK ALL RISK INSURANCE

Unless otherwise modified in the Supplementary Conditions, the Contractor shall secure and maintain during the life of this Contract, Builders Risk All Risk Insurance coverage in an amount equal to the full value of the facility under construction. Such insurance shall include coverage for earthquake, landslide, flood, collapse, and all other normally covered risks, and shall provide for losses to be paid to the Contractor, Owner, and Engineer as their interests may appear, but only if the Contractor is not in default as to any conditions of the Contract. The Builders Risk All Risk Insurance may be provided with a maximum of $1,000 deductible, and the difference in conditions supplement coverage may be provided with a maximum of $50,000 deductible; however, this shall not relieve the Contractor of the liability for this amount.

The Owner and Engineer, their officers, agents, and employees shall be named as additional insureds on the Contractor's and any Subcontractor's Builders Risk All Risk Insurance policies for any claims arising out of work performed under this Contract.

This insurance shall include a waiver of subrogation as to the Owner, the Engineer, the Contractor, and their respective officers, agents, employees, and Subcontractors.

G. OWNER'S PROTECTIVE COVERAGE

The CONTRACTOR shall maintain during this life of this Contract Owner's Protective coverage in the name of the OWNER in an amount not less than $1,000,000.

H. NO PERSONAL LIABILITY OF PUBLIC OFFICIALS

In carrying out any of the provisions hereof in exercising any authority granted by the Contract, there will be no personal liability upon any public official.

36. INDEMNITY

The Contractor shall indemnify and hold harmless the Owner, the Engineer, and their agents and employees from and against all claims, damages, losses, and expenses, including but not limited to, attorney's fees, arising out of or resulting from the performance of the work, provided that any such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease, or death, or to injury or to destruction of tangible property, including the loss of use resulting therefrom, or to any fine levied by a government authority, and is caused in whole or in part by any act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether the Contractor is or can be named a party in litigation and regardless of fault, breach of contract, or negligence of the Owner or Engineer, or their employees or agents, excepting only such claims or losses that have been adjudicated to have been caused solely by the negligence of the Owner or the Engineer.

In any and all claims against the Owner, the Engineer, or any of their agents or employees by any employee of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Article shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts, or other employee benefit acts.

The obligation of the Contractor under this Article shall not extend to the liability of the Engineer and its agents or employees arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or specifications.

The Contractor and all Subcontractors, their officers, agents, and employees, waive any right of subrogation which they may have against the Owner and the Engineer.

37. EXCLUSION OF CONTRACTOR CLAIMS

In performing its obligations, the Owner, Engineer and their consultants may cause expense for the Contractor or its Subcontractors and equipment or material suppliers. However, those parties and their sureties shall maintain no direct action against the Owner, Engineer, their officers, employees, agents, and consultants for any claim arising out of, in connection with, or resulting from the engineering services performed or required to be performed.

38. TAXES AND CHARGES

The Contractor shall withhold and pay any and all sales and use taxes and all withholding taxes, whether State or Federal, and pay all Social Security charges and also all State Unemployment Compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

39. REQUIREMENTS OF STATE LAW FOR PUBLIC WORKS PROJECTS

When the Contract Documents concern public works of the state or any county, municipality, or political subdivision created by its laws, the applicable statutes shall apply. All parties to this Contract shall determine the contents of all applicable statutes and comply with their provisions throughout the performance of the Contract.

40. CODES, ORDINANCES, PERMITS, AND LICENSES

The Contractor shall keep himself fully informed of all local codes and ordinances, as well as state and federal laws, which in any manner affect the work herein specified. The Contractor shall at all times comply with said codes and ordinances, laws, and regulations, and protect and indemnify the Owner, the Engineer and their respective employees, and its officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations. All permits, licenses, and inspection fees necessary for prosecution and completion of the work shall be secured and paid for by the Contractor, unless otherwise specified.

41. FINES

The Contractor shall be solely liable for any and all fines which may be levied by any government authority against the Owner and/or Contractor which are directly related to the Contractor's operations. The Contractor shall indemnify and hold the Owner harmless for any fine so levied against the Owner. The Owner may deduct the amount of the levied fine from partial payments as they become due and from final payment, or the amount shall be due and collectible from the Contractor or Surety.

42. SUPERINTENDENCE

The Contractor shall keep at the project site, competent supervisory personnel. The Contractor shall designate, in writing, before starting work, a Project superintendent who shall be an employee of the Contractor and shall have complete authority to represent and to act for the Contractor. Owner and Engineer shall be notified in writing before any change in superintendent assignment. The Contractor shall give efficient supervision to the work, using its best skill and attention. The Contractor shall be solely responsible for all construction means, methods, techniques, and procedures, and for providing adequate safety precautions and coordinating all portions of the work under the Contract. It is specifically understood and agreed that the Owner, Engineer, their employees and agents, shall not have control or charge of and shall not be responsible for the construction means, methods, techniques, procedures, or for providing adequate safety precautions in connection with the work under the Contract.

43. RECEPTION OF OWNER’S AND ENGINEER'S COMMUNICATIONS

The superintendent shall receive for the Contractor all communications from the Owner and Engineer. Communications of major importance will be confirmed in writing upon request from the Contractor.

The Owner or Engineer may schedule project meetings for the purposes of discussing and resolving matters concerning the various elements of the work. Time and place for these meetings and the names of persons required to be present shall be as determined by the Owner or Engineer. Contractor shall comply with these attendance requirements and shall also require its Subcontractors to comply.

44. SANITATION

Sanitary conveniences conforming to federal, state, and local codes shall be erected and maintained by the Contractor at all times while workers are employed on the work.

45. EMPLOYEES

The Contractor shall employ only competent, skillful workers to do the work, and whenever any worker shall become incompetent or to act in a disorderly, unsafe improper manner, such person shall promptly be removed from the work by the Contractor.

46. CONTRACTOR'S TOOLS AND EQUIPMENT

The Contractor's tools and equipment used on the work shall be furnished in sufficient quantity and of a capacity and type that will safely perform the work specified, and shall be maintained and used in a manner that will not create a hazard to persons or property, or cause a delay in the progress of the work.

47. INSPECTION BY CONTRACTOR

The Contractor shall observe and inspect the quality and accuracy of its own work and work executed by its subcontractors. Deficiencies found in the work shall be corrected prior to requesting inspection by the Owner or Engineer.

Inspection by the Owner or Engineer shall not relieve the Contractor from any obligation to perform the work strictly in accordance with the Contract Documents. Defective work shall be promptly removed and replaced by the Contractor at its own expense.

48. SAFETY

The Contractor shall be solely and completely responsible for conditions of the jobsite, including safety of all persons (including employees) and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. Safety provisions shall conform to U.S. Department of Labor (OSHA), and all other applicable federal, state, county, and local laws, ordinances, codes, and regulations. Where any of these are in conflict, the more stringent requirement shall be followed. The Contractor's failure to thoroughly familiarize himself with the aforementioned safety provisions shall not relieve him from compliance with the obligations and penalties set forth therein.

The Contractor shall develop and maintain for the duration of this Contract, a safety program that will effectively incorporate and implement all required safety provisions. The Contractor shall appoint an employee who is qualified and authorized to supervise and enforce compliance with the safety program.

The duty of the Owner or Engineer to conduct construction review of the work does not include review or approval of the adequacy of the Contractor's safety program, safety supervisor, or any safety measures taken in, on, or near the construction site.

The Contractor, as a part of its safety program, shall maintain at its office or other well-known place at the jobsite, safety equipment applicable to the work as prescribed by the aforementioned authorities, all articles necessary for giving first aid to the injured, and shall establish the procedure for the immediate removal to a hospital or a doctor's care of persons (including employees) who may be injured on the jobsite.

If death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Engineer and the Owner. In addition, the Contractor must promptly report in writing to the Owner or Engineer all the incidents whatsoever arising out of or in connection with, the performance of the work whether on, or adjacent to, the site, giving full details and statements of witnesses.

If a claim is made by anyone against the Contractor or any Subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Owner or Engineer, giving full details of the claim.

49. PROTECTION OF WORK AND PROPERTY

The Contractor shall at all times safely guard and protect from damage the Owner's property, adjacent property, and its own work from injury or loss in connection with this Contract. All facilities required for protection by federal, state, or municipal laws and regulations and local conditions must be provided and maintained.

The Contractor shall protect its work and materials from damage due to the nature of the work, the elements, carelessness of other contractors, or from any cause whatever until the completion and acceptance of the work. All loss or damages arising out of the nature of the work to be done under these Contract Documents, or from any unforeseen obstruction or defects which may be encountered in the prosecution of the work, or from the action of the elements, shall be sustained by the Contractor.

50. RESPONSIBILITY OF CONTRACTOR TO ACT IN EMERGENCY

In case of an emergency, which threatens loss or injury of property, and/or safety of life, the Contractor shall act, without previous instructions from the Owner or Engineer, as the situation may warrant. The Contractor shall notify the Owner or Engineer thereof immediately thereafter. Any claim for compensation by the

Contractor, together with substantiating documents in regard to expense, shall be submitted to the Owner or Engineer, and the amount of compensation shall be determined by agreement.

51. MATERIALS AND APPLIANCES

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, heat, light, fuel, power, transportation, construction equipment and machinery, appliances, telephone, sanitary facilities, temporary facilities, and other facilities and incidentals necessary for the execution and completion of the work. Unless otherwise specified, all materials shall be new, and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

In selecting and/or approving equipment for installation in the project, the Owner and Engineer assume no responsibility for injury or claims resulting from failure of the equipment to comply with applicable federal, state, and local safety codes or requirements, or the safety requirements of a recognized agency, or failure due to faulty design concepts, or defective workmanship and materials.

52. CONTRACTORS' AND MANUFACTURERS' COMPLIANCE WITH STATE SAFETY, OSHA, AND OTHER CODE REQUIREMENTS

The completed work shall include all necessary permanent safety devices, such as machinery guards and similar ordinary safety items required by the state and federal (OSHA) industrial authorities and applicable local and national codes. Further, any features of the work subject to such safety regulations shall be fabricated, furnished, and installed (including Owner-furnished equipment) in compliance with these requirements. Contractors and manufacturers of equipment shall be held responsible for compliance with the requirements included herein. Contractors shall notify all equipment suppliers and Subcontractors of the provisions of this Article.

In selecting and/or accepting equipment for installation in the project, neither the Owner nor Engineer assume responsibility for any personal injury, property damage, or any other damages or claims resulting from failure of the equipment to comply with applicable safety codes or requirements, or the safety requirements of a recognized agency, or failure due to manufacturer's faulty design concepts, or defective workmanship and materials. The Contractor shall indemnify and hold the Owner and Engineer harmless against any and all liability, claims, suits, damages, costs, or expenses without limitation arising out of the installation or use of such equipment.

53. SUBSTITUTION OF MATERIALS

Except for Owner-selected equipment items, and items where no substitution is clearly specified, whenever any material, article, device, product, fixture, form, type of construction, or process is indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. This procedure is not to be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable in design, and shall be deemed to be followed by the words "or equal."

The Contractor may, in such cases, submit complete data to the Owner or Engineer for consideration of another material, type, or process, which shall be substantially equal in every respect to that so indicated or specified. Substitute materials shall not be used unless approved in writing. The Owner. or Engineer if applicable, will be the sole judge of the substituted article or material.

To ensure standardization and uniformity in all parts of the work under this Contract, like items of equipment shall be the products of one manufacturer. Like items of certain materials shall be the products of one manufacturer.

Uniformity in like equipment items is required in order to provide the Owner with interchangeability capabilities, simplified spare parts inventory, and standardized maintenance programs, and manufacturers' services.

Uniformity in certain like material items is required in order to provide the Owner with a simplified spare materials inventory, continuity in patterns, color, and texture; and a standardized procedure for maintenance care and manufacturers' service.

Visible architectural items such as exterior finishes, floor and wall covering, ceiling materials, doors, windows, cabinetwork, paint, and miscellaneous appurtenances, when specified alike shall be standardized.

Generally, material items exempt from standardization include structural steel, reinforcing steel, building insulation, roofing materials, sheet metal, materials specified only by reference to a recognized standard, and items hidden from view where interchangeability, color,

and texture are not significant factors for standardization.

The Contractor shall inform its suppliers and subcontractors of these requirements, and shall provide the necessary coordination to accomplish the standardization specified.

If redesign of the work is required as a result of the substitution, the Contractor shall be solely responsible for reimbursing the Owner or Engineer for its costs. Reimbursement shall be based on the Owner's or Engineer's salary costs times a multiplier of 2.15 plus any direct nonlabor expenses such as travel or per diem. Salary costs are defined as raw labor costs plus salary overheads that are defined as a percentage of wages or salaries of employees working and premiums measured by or applicable at the time or performance to such wages or salaries such as, but not limited to, Workers' Compensation, insurance, Social Security, state and federal unemployment insurance, salary continuation insurance, pension plan costs, and prorated allowances for vacation, sick pay, and holiday pay.

54. TESTS, SAMPLES, AND OBSERVATIONS

The Contractor shall furnish, without extra charge, the necessary test pieces and samples, including facilities and labor for obtaining the same, as requested by the Owner or Engineer. When required, the Contractor shall furnish certificates of tests of materials and equipment made at the point of manufacture by a recognized testing laboratory.

The Owner, Engineer, and authorized government agents, and their representatives shall at all times be provided safe access to the work wherever it is in preparation or progress, and the Contractor shall provide facilities for such access and for observations, including maintenance of temporary and permanent access.

If the Specifications, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give timely notice of its readiness for observations. If any work should be covered up without approval or consent of the Owner or Engineer, it shall, if required by the Owner or Engineer, be uncovered for examination at the Contractor's expense.

Reexamination of questioned work may be ordered by the Owner or Engineer, and, if so ordered, the work shall be uncovered by the Contractor. If such work is found to be in accordance with the Contract Documents, the Owner will pay the cost of uncovering, exposure, observation, inspection, testing and reconstruction. If such work is found to be not in accordance with the Contract Documents, the Contractor shall correct the defective work, and the cost of reexamination and correction of the defective work shall be paid by the Contractor.

55. ROYALTIES AND PATENTS

The Contractor shall pay all royalty and license fees, unless otherwise specified. The Contractor shall defend all suits or claims for infringement of any patent rights and shall save the Owner and the Engineer harmless from any and all loss, including reasonable attorneys' fees, on account thereof.

56. CONTRACTOR'S RIGHT TO TERMINATE CONTRACT

If the work should be stopped under an order of any court or other public authority for a period of more than 3 months, through no act or fault of the Contractor, its Subcontractors, or respective employees or if the Engineer should fail to make recommendation for payment to Owner or return payment request to Contractor for revision within 30 days after it is due, or if the Owner should fail to pay the Contractor within 30 days after time specified in Article PARTIAL PAYMENTS, any sum recommended by the Engineer, then the Contractor may, upon 15 days' written notice to the Owner and the Engineer, stop work or terminate this Contract and recover from the Owner payment for all acceptable work performed and reasonable termination expenses, unless said default has been remedied.

57. CORRECTION OF DEFECTIVE WORK DURING WARRANTY PERIOD

The Contractor hereby agrees to make, at its own expense, all repairs or replacements necessitated by defects in materials or workmanship, provided under terms of this Contract, and pay for any damage to other works resulting from such defects, which become evident within 1 year after the date of final acceptance of the work (i.e., Contract Completion) or within 1 year after the date of substantial completion established by the Owner or Engineer for specified items of equipment, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents unless the Owner has previously given the Contractor a written acceptance of such defects. The Contractor shall promptly correct such defects upon receipt of a written notice from the Owner to do so. This obligation shall survive the termination of the Contract.

Unremedied defects identified for correction during the warranty period but remaining after its expiration shall

be considered as part of the obligations of the warranty. Defects in material, workmanship, or equipment which are remedied as a result of obligations of the warranty shall subject the remedied portion of the work to an extended warranty period of 1 year after the defect has been remedied.

Repetitive malfunction of equipment shall be cause for equipment replacement and an extension of the warranty period for the equipment to a date 1-year following acceptable replacement.
The Contractor further assumes responsibility for a similar warranty for all work and materials provided by Subcontractors or manufacturers of packaged equipment components. The effective date for the start of the warranty period for equipment qualifying as substantially complete is defined in Article SUBSTANTIAL COMPLETION, and Article SUBSTANTIAL COMPLETION DATE, in these General Conditions.

The Contractor also agrees to hold the Owner and the Engineer harmless from liability of any kind arising from damage caused by said defects. The Contractor shall make all repairs and replacements promptly upon receipt of written order for same from the Owner. If the Contractor fails to make the repairs and replacements promptly, or in an emergency where delay would cause serious risk, or loss, or damage, the Owner may have the defective work corrected or the rejected work removed and replaced, and the Contractor and its Surety shall be liable for the cost thereof.

PROGRESS OF THE WORK

58. BEGINNING OF THE WORK

Following execution of the Contract, the Contractor shall meet with the Owner and Engineer relative to its arrangements for prosecuting the work.

59. SCHEDULES AND PROGRESS REPORTS

Before starting the construction, the Contractor shall prepare and submit to the Owner or Engineer, a progress schedule showing the dates on which each part or division of the work is expected to be started and finished, and a preliminary schedule for submittals.

The progress schedule for submittals shall be brought up to date and submitted to the Owner or Engineer at the end of each month or at such other times the Owner or Engineer may request.

The Contractor shall forward to the Owner or Engineer, at the end of each month, an itemized report of the delivery status of major and critical items of purchased equipment and material, including shop drawings and the status of shop and field fabricated work. These progress reports shall show the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

If the completion of any part of the work or the delivery of materials is behind the submitted progress schedule, the Contractor shall submit in writing a plan acceptable to the Owner and Engineer for bringing the work up to schedule.

Failure of the Contractor to comply with the requirements of the Owner under this provision shall be grounds for determination by the Owner that the Contractor is not prosecuting the work with such diligence as will ensure completion within the time specified. Upon such determination, the Owner may terminate the Contractor's right to proceed with the work or any separable part thereof in accordance with Article "OWNER'S RIGHT TO DO WORK," and Article "OWNER'S RIGHT TO TRANSFER EMPLOYMENT."

The Owner shall have the right to withhold progress payments for the work if the Contractor fails to update and submit the progress schedule and reports as specified.

60. PROSECUTION OF THE WORK

It is expressly understood and agreed that the time of beginning, rate of progress, and time of completion of the work are the essence of this Contract. The work shall be prosecuted at such time, and in or on such part or parts of the project as may be required, to complete the project as contemplated in the Contract Documents and the progress schedule.

A. OVERTIME NOTICE

No work shall be done between 6:00 p.m. and 7:00 a.m., nor on Sundays or legal holidays without the written permission of the Owner. However, emergency work during these hours may be done without prior permission.

Night work may be established by the Contractor as regular procedure with the written permission of the Owner. Such permission, however, may be revoked at any time by the Owner if the Contractor fails to maintain adequate equipment and supervision for the proper execution and control of the work at night.

If the Contractor, at its own expense, should desire to carry on its work at night or outside regular hours, he

shall submit written notice to the Owner or Engineer and he shall allow ample time for satisfactory arrangements to be made for inspecting the work in progress. At no time shall the notice be given less than 24 hours before such overtime work is started. The Contractor must obtain, through the Engineer if applicable, the Owner's approval for work at night or on Sundays. The Contractor shall light the different parts of the project as required to comply with all applicable federal and state regulations and with all applicable requirements of the Owner.

B. OVERTIME WORK BY OWNER, EMPLOYEES, AND AGENTS

Overtime hours shall be considered any hours worked by the Contractor in excess of 40 hours from Monday through Saturday, and/or any time on Sunday and legal holidays, which in the Owner's or Engineer's opinion requires the Owner's or Engineer's resident observers' presence to observe such overtime work. In general, it should be expected that the Owner's or Engineer's resident observer(s) will be present at all times that the Contractor is working.

If the Contractor elects to schedule and perform overtime work, the Contractor shall pay the Owner for the Owner's or Engineer's resident observers' salary costs for each hour of overtime work times a multiplier of 2.15 for overhead and profit. Overtime shall be rounded off to the nearest whole hour. Salary costs shall include, but are not limited to, such items as insurance, social security, workers' compensation, sick pay, paid holidays, and vacation pay. In addition, any direct nonlabor expenses that in the Owner's or Engineer's opinion are attributable to the Contractor's overtime such as unanticipated lodging, travel, or per diem, with a limit of $60.00 per day for such direct nonlabor expenses, shall be paid to the Owner.

Payment to the Owner shall be made by a deduction from the Contractor's monthly payment invoice. Should the Contractor work overtime, incurring overtime cost deductions as described above, and subsequently complete the construction within the contract period, then a rebate for the resident observer's overtime shall be made. Such rebate shall be based on the average hourly overtime cost incurred, multiplied by the number of workdays remaining in the original contract period, or as extended, and multiplied by 8 hours per workday. Any rebate made to the Contractor shall not exceed the total amount of overtime cost deducted. If the Contractor exceeds the original or extended contract period, no rebate shall be paid.

61. OWNER'S RIGHT TO RETAIN IMPERFECT WORK

If any part or portion of the work completed under this Contract shall prove defective and not in accordance with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the work dangerous or unsuitable, or if the removal of such work will create conditions which are dangerous or undesirable, the Owner shall have the right and authority to retain such work but will make such deductions in the final payment therefor as may be just and reasonable.

62. OWNER'S RIGHT TO DO WORK

Should the Contractor neglect to prosecute the work in conformance with the Contract Documents or neglect or refuse at its own cost to remove and replace work rejected by the Owner or Engineer, then the Owner may notify the Surety of the condition, and after 10 days' written notice to the Contractor and the Surety, or without notice if an emergency or danger to the work or public exists, and without prejudice to any other right which the Owner may have under the Contract, or otherwise, take over that portion of the work which has been improperly or nontimely executed, and make good the deficiencies and deduct the cost thereof from the payments then or thereafter due the Contractor.

63. OWNER'S RIGHT TO TRANSFER EMPLOYMENT

If the Contractor should abandon the work or if he should persistently or repeatedly refuse or should fail to make prompt payment to Subcontractors for material or labor, or to persistently disregard laws, ordinances, or to prosecute the work in conformance with the Contract Documents, or otherwise be guilty of a substantial violation of any provision of the contract or any laws or ordinance, then the Owner may, without prejudice to any other right or remedy, and after giving the Contractor and Surety 10 days' written notice, transfer the employment for said work from the Contractor to the Surety. Upon receipt of such notice, such Surety shall enter upon the premises and take possession of all materials, tools, and appliances thereon for the purpose of completing the work included under this Contract and employ, by Contract or otherwise, any qualified person or persons to finish the work and provide the materials therefor, in accordance with the Contract Documents, without termination of the continuing full force and effect of this Contract. In case of such transfer of employment to such Surety, the Surety shall be paid in its own name on estimates according to the terms hereof without any right of the Contractor to make any claim for the same or any part thereof.

If, after the furnishing of said written notice to the

Surety, the Contractor and the Surety still fail to make reasonable progress on the performance of the work, the Owner may terminate the employment of the Contractor and take possession of the premises and of all materials, tools, and appliances thereon and finish the work by whatever method he may deem expedient and charge the cost thereof to the Contractor and Surety. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished. If the expense of completing the Contract, including compensation for additional managerial and administrative services, shall exceed such unpaid balance, the Contractor and the Surety shall pay the difference to the Owner.

64. DELAYS AND EXTENSION OF TIME

If the Contractor is delayed in the progress of the work by any act or neglect of the Owner or the Engineer, or by any separate Contractor employed by the Owner, or by strikes, lockouts, fire, adverse weather conditions not reasonably anticipated, or acts of Nature, and if the Contractor, within 48 hours of the start of the occurrence, gives written notice to the Owner of the cause of the potential delay and estimate of the possible time extension involved, and within 10 days after the cause of delay has been remedied, the Contractor gives written notice to the Owner of any actual time extension requested as a result of the aforementioned occurrence, then the Contract time may be extended by Change Order for such reasonable time as the Owner or Engineer determines. It is agreed that no claim shall be made or allowed for any damages, loss, or expense which may arise out of any delay caused by the above referenced acts or occurrences, other than claims for the appropriate extension of time.

No extension of time will be granted to the Contractor for delays occurring to parts of the work that have no measurable impact on the completion of the total work under this Contract, as determined by the Owner or Engineer based upon the most recently submitted update of the progress schedule. If the Critical Path Method (CPM) is used for scheduling the work, determinations regarding such impacts on the completion of the total work shall be based on impacts to the items of work on the critical path. No extension of time will be considered for weather conditions reasonably anticipated for the area in which the work is being performed. Reasonably anticipated weather conditions will be based on official records of monthly precipitation and other historical data. Adverse weather conditions, if determined to be of a severity that would affect progress of the work, may be considered as cause for an extension of Contract completion time.

Delays in delivery of equipment or material purchased by the Contractor or its Subcontractors, including Owner-selected equipment, shall not be considered as a just cause for delay, unless the Owner determines that for good cause the delay is beyond the control of the Contractor. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

Within a reasonable period after the Contractor submits to the Owner a written request for an extension of time, the Engineer, if applicable, will present its written opinion to the Owner as to whether an extension of time is justified, and, if so, its recommendation as to the number of days for time extension. The Owner will make the final decision on all requests for extension of time.

65. DIFFERING SITE CONDITIONS

The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Owner and Engineer of:

A. subsurface or latent physical conditions at the site which differ materially from those indicated in this Contract, or

B. unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

The Owner or Engineer will investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ as determined by the Owner or Engineer and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this Contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this Article and the Contract modified in writing accordingly.

No request by the Contractor for an equitable adjustment to the Contract under this Article will be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed above for giving written notice may be extended by the Owner.

Nothing in this section shall relieve the Contractors responsibility to inform himself of the conditions relating to the work and inspection of the jobsite. Contractor will be charged with knowledge of site conditions generally prevailing in the area of the jobsite.

No request by the Contractor for an equitable adjustment

to the Contract for differing site conditions will be allowed if made after final payment under this Contract.

66. LIQUIDATED DAMAGES

Should the Contractor fail to achieve substantial completion within the time periods agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall pay the Owner liquidated damages at the per diem rate stipulated in the Contract Documents for each calendar day, Sundays and legal holidays included, until the Contractor achieves substantial completion. It is agreed that the specified amount of liquidated damages is a reasonable estimate of the actual damages which the Owner is likely to incur as the result of the Contractor's delay, and that said liquidated damages are in addition to expenses for engineering, legal, and resident observation services and for any fines that the Owner becomes obligated to pay due to the Contractor's failure to achieve substantial completion within the agreed upon time. It is expressly understood and agreed that this amount of liquidated damages is not to be considered in the nature of a penalty, but as estimated actual damages which the Owner is likely to incur as a result of the Contractor's delay, and in addition to the damages resulting from expenses for engineering, legal, and resident observation services and for any fines that the Owner may become obligated to pay due to failure of the Contractor to achieve the substantial completion and/or final completion dates established in the Contract. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or Surety.

67. OTHER CONTRACTS

The Owner reserves the right to let other Contracts in connection with the work. 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 its work with theirs.

If any part of the work under this Contract depends for proper execution or results upon the work of any other Contractor, utility service company or Owner, the Contractor shall inspect and promptly report to the Owner or Engineer in writing any patent or apparent defects or deficiencies in such work that render it unsuitable for such proper execution and results. The Contractor's failure to so report shall constitute an acceptance of the work by others as being fit and proper for integration with work under this Contract, except for latent or non- apparent defects and deficiencies in the work.

68. USE OF PREMISES

The Contractor shall confine its equipment, the storage of materials, and the operation of its workers to limits shown on the Drawings or indicated by law, ordinances, permits, or directions of the Owner or Engineer, and shall not unreasonably encumber the premises with its materials. The Contractor shall provide, at its own expense, the necessary rights-of-way and access to the work which may be required outside the limits of the Owner's property and shall furnish the Owner or Engineer copies of permits and agreements for use of property outside that provided by the Owner.

Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the work or adjacent property to stresses or pressures that will endanger it.

69. PERFORMANCE TESTING

Operating equipment and systems shall be performance tested in the presence of the Owner or Engineer to demonstrate compliance with the specified requirements. Performance testing shall be conducted under the specified design operating conditions or under such simulated operating conditions as recommended or approved by the Owner or Engineer. Scheduling of such testing with the Owner or Engineer must be at least 1 week in advance of the planned date for testing.

70. OWNER'S USE OF PORTIONS OF THE WORK

Following issuance of the written notice of Substantial Completion, the Owner may initiate operation of the facility. Such use shall not be considered as final acceptance of any portion of the work, nor shall such use be considered as cause for an extension of the Contract completion time, unless authorized by a Change Order issued by the Owner.

71. CUTTING AND PATCHING

The Contractor shall do all cutting, fitting, or patching of its work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors shown upon or reasonably implied by the Drawings.

Any defective work or material, performed or furnished by the Contractor that may be discovered by the Owner or Engineer before final acceptance of the work or before

final payment has been made, shall be promptly removed and replaced or patched in a manner as approved by the Owner or Engineer at the expense of the Contractor.

72. CLEANING UP

The Contractor shall, at all times, keep property on which work is in progress and the adjacent property free from accumulations of waste material or rubbish caused by employees or by the work. Upon completion of the construction, the Contractor shall remove all temporary structures, rubbish, and waste materials resulting from its operations.

73. FINAL INSPECTION

Upon notice from the Contractor that its work is complete, the Engineer and/or other representatives of the Owner shall make a final inspection of the work or project and conduct test or tests if applicable. The Owner or Engineer shall notify the Contractor of all apparent and/or visible instances where its work fails to comply with the Plans and Specifications and Contract Document, as well as any defects he may discover (punch list). The Contractor shall immediately make such alterations as are necessary to make the work comply with the Plans and Specifications and to the satisfaction of the Owner or Engineer.

Upon completion of all such repairs in a satisfactory manner, and when the Owner or Engineer has determined that the work or project is acceptable under the Contract, including this provision and completion of publication and all other requirements of final payment as provided for in this agreement, then it shall issue a final certificate of payment to Owner stating that the balance is due the Contractor, less such amounts as may have been withheld by the Owner from time-to-time as provided in the Contract Documents. In recommending to the Owner that it make such final payment to the Contractor, the Engineer, if applicable, shall also issue a certificate of final acceptance wherein he shall recommend to the Owner that it accept the project and/or work as final and complete pursuant to the Contract Documents.

Verification, approval, inspection, final inspection, issuance of final acceptance, issuance of final certificate of payment, action or approval by the Owner upon the final certificate of payment, or final acceptance shall not in any way relieve the Contractor of responsibility for faulty materials or workmanship.

74. DISPUTES

All claims by the Contractor arising from interpretation of or performance under the Contract Documents shall be submitted in writing to the Owner or Engineer promptly, but in no event later than 10 days after the start of the occurrence or event giving rise thereto. The Owner or Engineer shall issue its determination in writing to the Contractor. If the Contractor considers that a determination made by the Owner or Engineer is not in accord with the meaning and intent of the Contract, the Contractor may, within 15 days from the receipt of the determination, file with the Owner a written request for reconsideration. The Owner shall reconsider this initial determination and render a final determination on the issue, which shall be final and conclusive under this Contract. Failure to file either request for reconsideration or for appeal within the required 15 days shall render the determination issued final.

75. REMEDIES

The parties shall attempt in good faith to resolve any controversy or dispute arising out of or relating to this Agreement promptly by negotiations. If any party reaches the conclusion that the controversy or dispute cannot be resolved by unassisted negotiations, such party may notify the American Arbitration Association ("AAA") in Atlanta, Georgia. AAA shall promptly designate a mediator who is independent and impartial, and AAA's decision about the identity of the mediator shall be final and binding. The parties agree to conduct at least eight (8) consecutive hours of mediated negotiations in Montgomery, Alabama within thirty (30) days after the first notice is sent to AAA. If the dispute is not resolved by negotiation or mediation within thirty (30) days after the notice to AAA is sent, then, upon notice by any party to the other party and to AAA, the controversy or dispute shall be submitted to a sole arbitrator who is independent and impartial, selected by AAA, for binding arbitration to be conducted in Montgomery, Alabama in accordance with AAA's Construction Industry Arbitration Rules. The parties agree that they shall faithfully observe the terms of this paragraph and shall abide by and perform any award rendered by the arbitrator. The award or judgment of the arbitrator shall be final and binding on all parties. No litigation or other proceeding may be instituted in any court for the purpose of adjudicating, interpreting or enforcing any of the rights or obligations relating to the subject matter hereof, whether or not covered by the express terms of this Agreement, or for the purpose of adjudicating a breach or determination of the validity of this Agreement, or for the purpose of appealing any decision or an arbitrator, except a proceeding instituted for the sole purpose of having the award of judgment of an arbitrator entered and enforced.

PAYMENT

76. PAYMENT FOR CHANGE ORDERS

The Owner's request for quotations on alterations to the work shall not be considered authorization to proceed with the work before the issuance of a formal Change Order, nor shall such request justify any delay in existing work. Quotations for alterations to the work shall include substantiating documentation with an itemized breakdown of Contractor and Subcontractor costs, including labor, material, rentals, approved services, overhead, and profit. Owner may require detailed cost data in order to substantiate the reasonableness of the proposed costs.

Any compensation paid in conjunction with the terms of a Change Order shall comprise total compensation due the Contractor for the work or alteration defined in the Change Order. By signing the Change Order, the Contractor acknowledges that the stipulated compensation includes payment for the work or alteration plus all payment for the interruption of schedules, extended overhead, delay, or any other impact claim or ripple effect, and by such signing specifically waives any reservation or claim for additional compensation in respect to the subject Change Order.

At the Owner's option, payment or credit for any alterations covered by a Change Order shall be determined by one or a combination of the methods set forth in A, B, or C below, as applicable:

A. UNIT PRICES

Those unit prices stipulated in the Proposal shall be used where they are applicable. In the event the Change Order results in a change in the original quantity that is materially and significantly different from the original bid quantity, a new unit price shall be negotiated upon demand of either party. Unit prices for new items included in the Change Order shall be negotiated and mutually agreed upon.

B. LUMP SUM

A total lump sum for the work negotiated and mutually acceptable to the Contractor and Owner.
Lump sum quotations for modifications to the work shall include substantiating documentation with an itemized breakdown of Contractor and Subcontractor costs, including labor, material, rentals, approved services, overhead, and profit, all calculated as specified under "C" below.

C. COST REIMBURSEMENT WORK

The term "cost reimbursement" shall be understood to mean that payment for the work will be made on a time and expense basis, that is, on an accounting of the Contractor's forces, materials, equipment, and other items of cost as required and used to do the work.

If the method of payment cannot be agreed upon before the beginning of the work, and the Owner directs by written Change Order that the work be done on a cost reimbursement basis, then the Contractor shall furnish labor, and furnish and install equipment and materials necessary to complete the work in a satisfactory manner and within a reasonable period of time. For the work performed, payment will be made for the documented actual cost of the following:

1. Labor, including foremen, for those hours they are assigned and participating in the cost reimbursement work (actual payroll cost, including wages, fringe benefits as established by negotiated labor agreements, labor insurance, and labor taxes as established by law). No other fixed labor burdens will be considered, unless approved in writing by the Owner.

2. Material delivered and used on the designated work, including sales tax, if paid for by the Contractor or its Subcontractor.

3. Rental, or equivalent rental cost of equipment, including necessary transportation for items having a value in excess of $100.

   Rental or equivalent rental cost will be allowed for only those days or hours during which the equipment is in actual use. Rental and transportation allowances shall not exceed the current rental rates prevailing in the locality. The rentals allowed for equipment will, in all cases, be understood to cover all fuel, supplies, repairs, and renewals, and no further allowances will be made for those items, unless specific agreement to that effect is made.

4. Additional bond, as required and approved by the Owner.

5. Additional insurance (other than labor insurance) as required and approved by the Owner.

In addition to items 1 through 5 above, an added fixed fee for general overhead and profit shall be negotiated and allowed for the Contractor (or approved Subcontractor) actually executing the Cost

Reimbursement work.

An additional fixed fee shall be negotiated and allowed the Contractor for the administrative handling of portions of the work that are executed by an approved Subcontractor. No additional fixed fee will be allowed for the administrative handling of work executed by a Subcontractor of a Subcontractor, unless by written permission from the Owner.

The added fixed fees shall be considered to be full compensation, covering the cost of general supervision, the cost involved in the development of the Change Order, overhead, profit, and any other general expense. Should the Change Order involve deletion of work, the Contractor shall include in the credit an amount equal to the fixed fees calculated as if the work were added as new work but of opposite sign (i.e., credited back to the Owner). Should the final net amount of change orders be negative, a percentage of the negative amount, if stated in the Supplementary Conditions, will be added to the current Contract amount for lost profit.

The Contractor's records shall make clear distinction between the direct costs of work paid for on a cost reimbursement basis and the costs of other work. The Contractor shall furnish the Owner or Engineer report sheets in duplicate of each day's cost reimbursement work no later than the working day following the performance of said work. The daily report sheets shall itemize the materials used, and shall cover the direct cost of labor and the charges for equipment rental, whether furnished by the Contractor, Subcontractor, or other forces. The daily report sheets shall provide names or identifications and classifications of workers, the hourly rate of pay and hours worked, and also the size, type, and identification number of equipment and hours operated.
Material charges shall be substantiated by valid copies of vendors' invoices. Such invoices shall be submitted with the daily report sheets, or, if not available, they shall be submitted with subsequent daily report sheets. Said daily report sheets shall be signed by the Contractor or its authorized agent.
The Owner reserves the right to furnish such materials and equipment as he deems expedient, and the Contractor shall have no claim for profit or added fees on the cost of such materials and equipment.

To receive partial payments and final payment for cost reimbursement work, the Contractor shall submit to the Owner or Engineer, in a manner approved by the Owner or Engineer, detailed and complete documented verification of the Contractor's and any of its Subcontractors' actual costs involved in the cost reimbursement work. Such costs shall be submitted within 30 days after said work has been performed.

77. PARTIAL PAYMENTS

A. GENERAL

Nothing contained in this Article shall be construed to affect the right, hereby reserved, to reject the whole or any part of the aforesaid work, should such work be later found not to comply with the provisions of the Contract Documents. All estimated quantities of work for which partial payments have been made are subject to review and correction on the final estimate. Payment by the Owner and acceptance by the Contractor of partial payments based on periodic estimates of quantities of work performed shall not, in any way, constitute acceptance of the estimated quantities used as the basis for computing the amounts of the partial payments.

B. CONTRACT PRICE BREAKDOWN FOR LUMP SUM WORK

The Contractor shall present a price breakdown of the Contract amount to the Owner or Engineer with the Preliminary Construction Schedule and before the first partial payment is made. The price breakdown shall be subject to the approval of the Owner or Engineer as to content and form and the Contractor may be required to verify the prices for any or all items. The price breakdown as agreed upon by the Contractor and Engineer shall be used for preparing future estimates for partial payments to the Contractor, and shall list the major items of the work and prices for each item. Overhead, other general costs, and profit shall be prorated to each item so that the total of the prices for all items equals the Contract Amount.

The price breakdown shall be revised by the Contractor to reflect changes to the Contract Amount and submitted to the Owner or Engineer for approval with each monthly update of the Construction Schedule. The line items affected by revision due to execution of Contract Modifications shall be clearly identified in the revised price breakdown. If the revised price breakdown has not been received by the Owner or Engineer as described herein before or should the revised price breakdown prove unsatisfactory to the Owner or Engineer, the Owner or Engineer will refuse to recommend the next and all subsequent pay estimate requests received until a satisfactory revised price breakdown has been obtained.

C. ESTIMATE

At least 30 days before each progress payment falls due, the Contractor shall submit to the Owner or Engineer a detailed estimate of the amount earned during the preceding month for the separate portions of the work,

and request payment. As used in this Article, the words "amount earned" mean the value, on the date of the estimate for partial payment, of the work completed in accordance with the Contract Documents, and the value of approved materials delivered to the project site suitably stored and protected before incorporation into the work.

The Engineer, if applicable will, within 7 days after receipt of each request for payment, either indicate in writing a recommendation of payment and present the request to the Owner, or Owner or Engineer may return the request to the Contractor indicating in writing the reasons for refusing to recommend or make payment. If payment is not recommended or made, the Contractor may, within 7 days, make the necessary corrections and resubmit the request.

The Owner or Engineer, if applicable, may refuse to make or recommend the whole or any part of any payment if, in Owner's or Engineers opinion, payment has not been earned or should not be made pursuant to the Contract Documents. The Owner or Engineer, if applicable, also may refuse to make or recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously approved or recommended to such extent as may be necessary in the Owner's or Engineer's opinion to protect the Owner from loss because:

1. The work is defective, or completed work has been damaged requiring correction or replacement;
2. Written claims have been made against the Owner or Liens have been filed in connection with the work;
3. The Contract Price has been reduced because of Change Orders;
4. The Owner has been required to correct defective work or complete the work in accordance with Article OWNER'S RIGHT TO DO WORK;
5. Of the Contractor's unsatisfactory prosecution of the work in accordance with the Contract Documents; or
6. The Contractor's failure to make payment to Subcontractors or for labor, materials, or equipment.

By approving or recommending any such payment, the Owner or Engineer will not thereby be deemed to have represented that exhaustive or continuous onsite inspections have been made to check the quality or the quantity of the work beyond the responsibilities specifically assigned to the Owner or Engineer in the Contract Documents or that there may not be other matters or issues between the parties that might entitle the Contractor to be paid additionally by the Owner or the Owner to withhold payment to the Contractor.

D. DEDUCTION FROM ESTIMATE

Unless modified in the Supplementary Conditions, deductions from the estimate will be as described below:

1. The Owner will deduct from the estimate, and retain as part security, 5 percent of the amount earned for work satisfactorily completed. A deduction and retainage of 5 percent will be made on the estimated amount earned for approved items of material delivered to and properly stored at the jobsite, or suitably stored and insured off-site. After 50 percent completion has been accomplished, no additional retainage shall be withheld.

E. QUALIFICATION FOR PARTIAL PAYMENT FOR MATERIALS DELIVERED

Unless modified in the Supplementary Conditions, qualification for partial payment for materials delivered but not yet incorporated into the work shall be as described below:

1. Materials, as used herein, shall be considered to be those items, which are fabricated and manufactured material and equipment. No consideration shall be given to individual purchases of less than $600 for any one item.

2. To receive partial payment for materials delivered to the site, but not incorporated in the work, it shall be necessary for the Contractor to include a list of such materials on the Partial Payment Request. At its sole discretion, the Owner or Engineer, if applicable, may approve items for which partial payment is to be made. Partial payment shall be based on the Contractor's actual cost for the materials as evidenced by invoices from the supplier. Proper storage and protection shall be provided by the Contractor, and as approved by the Owner or Engineer. Final payment shall be made only for materials actually incorporated in the work and, upon acceptance of the work, all materials remaining for which advance payments had been made shall revert to the Contractor, unless otherwise agreed, and partial payments made for these items shall be deducted from the final payment for the work.

3. Contractor warrants and warranties that title to all work, materials, and equipment covered by any Application for Payment, whether incorporated in the project or not, will pass to the Owner at the time of payment free and clear of all liens, claims, security interests, and encumbrances.

4. If requested by the Owner or Engineer, the Contractor shall provide, with subsequent pay requests, invoices receipted by the supplier showing payment in full has been made.

F. PAYMENT

After deducting the retainage and the amount of all previous partial payments made to the Contractor from the amount earned, the amount due will be made payable to the Contractor. Invoices will be paid within 30 days after receipt of a pay request approved by the Owner or Engineer.

78. CLAIMS FOR EXTRA WORK

In any case where the Contractor deems additional time or compensation will become due him under this Contract for circumstances other than those defined in Article DELAYS AND EXTENSION OF TIME, the Contractor shall notify the Owner or Engineer, in writing, of its intention to make claim for such time or compensation before he begins the work on which he bases the claim, in order that such matters may be settled, if possible, or other appropriate action promptly taken. The notice of claim shall be in duplicate, in writing, and shall state the circumstances and the reasons for the claim, but need not state the amount. If such notification is not given or the Owner or Engineer are not afforded proper facilities by the Contractor for keeping strict account of actual cost, then the Contractor hereby agrees to waive the claim for such time or additional compensation. Such notice by the Contractor, and the fact that the Owner or Engineer has kept account of the cost as aforesaid, shall not in any way be construed as proving the validity of the claim.

No extension of time will be granted to the Contractor for delays resulting from extra work that has no measurable effect on the completion of the total work under this Contract.

Claims for additional time or compensation shall be made in itemized detail and submitted, in writing, to the Owner and Engineer, if applicable, within 10 days following completion of that portion of the work for which the Contractor bases its claim. Failure to make the claim for additional compensation in the manner and within the time specified above shall constitute waiver of that claim. In case the claim is found to be just, it shall be allowed and paid for as provided in Article PAYMENT FOR CHANGE ORDERS.

79. RELEASE OF LIENS OR CLAIMS

The Contractor shall indemnify and hold harmless the Owner from all claims for labor and materials furnished under this Contract. Before the final payment, the Contractor shall furnish to the Owner, as part of its final payment request, a certification that all of the Contractor's obligations on the project have been satisfied and that all monetary claims and indebtedness have been paid. The Contractor shall furnish complete and legal effective releases or waivers, satisfactory to the Owner, of all liens arising out of or filed in connection with the work, and the CONTRACTOR shall also provide the OWNER with a general release and waiver prepared by OWNER and provided to CONTRACTOR at the time that CONTRACTOR makes its request for final payment.

80. NOTICE OF COMPLETION / FINAL PAYMENT

A. NOTICE OF COMPLETION

Upon completion of all of the work under this Contract, the Contractor shall notify the Owner and Engineer, if applicable, in writing, that he has completed its part of the Contract and shall request final payment. Upon receipt of such notice, the Owner or Engineer will inspect and, if acceptable, will authorize the Contractor to publish a Notice of Completion. Upon receipt of authorization from the Owner or Engineer, the Contractor shall publish a Notice of Completion in a Montgomery, Alabama newspaper at least once per week for 4 consecutive weeks. The Contractor shall give proof of publication to the Owner or Engineer. Contractor shall also obtain from the Surety liable under all payment and performance bonds required under the Contract Documents a Consent of Surety to Final Payment in a form satisfactory to the OWNER.

B. FINAL PAYMENT

Upon receipt of the proof of publication from the Contractor, the Owner will determine whether the completed work is acceptable to Owner and formulate a final estimate of the amount due the Contractor, or the Engineer, if applicable, will submit to the Owner its recommendation as to acceptance of the completed work and as to the final estimate of the amount due the Contractor. Upon approval of this final estimate by the Owner and compliance by the Contractor with provisions in this Article and the Article RELEASE OF

LIENS OR CLAIMS, and other provisions of the Contract Documents as may be applicable, the Owner shall pay to the Contractor all monies due him under the provisions of these Contact Documents. Final payment shall not be made earlier than 30 days from the last date that the Notice of Completion was published.

81. NO WAIVER OF RIGHTS

Neither the inspection by the Owner or Engineer, if applicable, or any of its employees, nor any order by the Owner for payment of money, nor any payment for, or acceptance of, the whole or any part of the work by the Owner or Engineer, nor any extension of time, nor any possession taken by the Owner or its employees, shall operate as a waiver of any provision of this Contract, or any power herein reserved to the Owner, or any right to damages herein provided, nor shall any waiver of any breach in this Contract be held to be a waiver of any other or subsequent breach. Acceptance or final payment shall not be final and conclusive with regards to latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under the warranty.

82. ACCEPTANCE OF FINAL PAYMENT CONSTITUTES RELEASE

The acceptance by the Contractor of the final payment shall release the Owner and the Engineer, as representatives of the Owner, from all claims and all liability to the Contractor for all things done or furnished in connection with the work, and every act of the Owner and others relating to or arising out of the work except claims previously made in writing and still unsettled. No payment, however, final or otherwise, shall operate to release the Contractor or its Sureties from obligations under this Contract and the Performance Bond, Payment Bond, and other bonds and warranties, as herein provided.

SUPPLEMENTARY CONDITIONS

REVISIONS AND ADDITIONS TO THE GENERAL CONDITIONS

The General Conditions are hereby revised as follows:

ARTICLE 35, "INSURANCE AND LIABILITY"

1. Under Item D, GENERAL LIABILITY INSURANCE (INCLUDING AUTOMOBILE), after the first paragraph, add the following paragraph:

   The amount of insurance to be provided shall be $1,000,000 per occurrence or greater combined single limit, plus umbrella liability for the general liability and automobile liability insurance in an amount not less than $5,000,000 per occurrence in excess of the above stated primary limits.

2. Under Item F, BUILDERS RISK ALL RISK INSURANCE, delete this item and substitute the following:

   F. INSTALLATION FLOATER

   The CONTRACTOR shall secure and maintain during the life of this Contract, an Installation Floater in an amount sufficient to cover the property to be installed. Such coverage shall provide for losses to be paid to the CONTRACTOR and the OWNER as their interests may appear, but only if the CONTRACTOR is not in default as to the conditions of the Contract. This coverage may be provided with a maximum of $1,000.00 deductible; however, this shall not relieve the CONTRACTOR of the liability for this amount.

ARTICLE 58, "BEGINNING OF THE WORK"

Delete the article and substitute the following:

58. PRECONSTRUCTION CONFERENCE

Within 14 days following Execution of Contract but before CONTRACTOR starts the work at the site, the CONTRACTOR shall meet with the OWNER for discussion of scheduling requirements, procedures for handling shop drawings and other submittals and for processing Applications for Payment, and to establish a working understanding among the parties as to the work

ARTICLE 59, “SCHEDULES AND PROGRESS REPORTS”

After the first paragraph, add the following paragraph:

The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion at any time. The CONTRACTOR shall enter on the chart the actual progress at such intervals as directed by the OWNER, and shall deliver to the OWNER three copies thereof within 24 hours of the start of construction. If the CONTRACTOR fails to submit a progress schedule within the time herein prescribed, the OWNER may withhold approval of progress payment estimates until such time as the CONTRACTOR submits the required progress schedule.

ARTICLE 64, “DELAYS AND EXTENSIONS OF TIME”

After the first paragraph, add the following 2 paragraphs:

Claims for additional time due to adverse weather associated with rain shall be based on the number of rain days, if any, in excess of the average number of rain days for the month at issue in Montgomery County, Alabama. All such determinations are to be based on the official weather reports and records of the National Oceanic and Atmospheric Administration (NOAA). The average number of rain days for a month shall be based on the average number of rain days for that particular month as presented in the NOAA-Southeast Regional Climate Center database.

Additional contract days due to rain will be added for days where the actual number of rain days is above that which is average for the month at issue in Montgomery County. The addition of rain days to the contract will be added at the rate of 1 day for each day of rain above the average for the month where the actual daily precipitation is between .10 inches and .50 inches of rain. 2 days will be granted for each day of rain above the average for the month where the actual daily precipitation is greater than .50 inches.

ARTICLE 76, “PAYMENT FOR CHANGE ORDERS”, SUBARTICLE C, “COST REIMBURSEMENT WORK”

Delete the first and second subparagraphs and replace with the following:

In addition to the actual costs in Items 1 through 5 above, there shall be added the following fixed fees for the CONTRACTOR or subcontractor actually performing the work:

A. A fixed fee of 20 percent of the cost of Item 1, above.
B. A fixed fee of 10 percent added to the cost of Items 2 and 3 above.
C. A fixed fee of 6 percent added to the cost of Items 4 and 5 above.

An additional fixed fee of 10 percent shall be allowed the CONTRACTOR for the administrative handling of portions of the work that are performed by an approved Subcontractor. No additional fixed fee will be allowed for the administrative handling of work performed by a Subcontractor of a Subcontractor, unless by written permission from the OWNER.

PART 4 SPECIFICATIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of two separate scope Schedules. The Project Schedules include, but are not limited to the following:

1. Schedule A:
   a. Installation of new piping to bypass influent flows around the existing headworks to the existing splitter box.
   b. Installation of new piping to reroute plant drain discharge to the existing splitter box.
2. Schedule B:
   a. Installation of a new tank mounted spiral screening system for temporary use.
   b. Installation of new metal platform to elevate the new screen to meet the existing influent pump and plan hydraulic conditions.
   c. Installation of piping to connect the new screen to the bypass piping installed in Schedule A.
   d. Installation of plant water line to the new tank mounted spiral screening system.
   e. Installation of new gravel drive to the new tank mounted spiral screening system.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Contractor's standard form.
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Lump Sum Work:

1. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
   b. Include item(s) for monthly progress schedule update.
2. Break down by Division 2 through 44 with appropriate subdivision of each specification for each Project facility

D. An unbalanced or front-end loaded schedule will not be acceptable.

E. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule.

B. Use detailed Application for Payment Form provided by Engineer.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Construction Photographs/Videos.

F. Each Application for Payment shall include detailed breakdowns for all items requested for payment, including manhole numbers and pipe segments as identified on the Drawings to positively identify each item for payment.

G. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

H. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.05 MEASUREMENT AND PAYMENT

A. Payment for unit price items covers all the labor, materials, equipment, and services necessary to furnish, install and test all of the bid items as designated on the Bid Form and in individual technical Specifications. Any item necessary to complete the installation or identified as required on the Drawings or Specifications but not designated for separate payment, shall be considered incidental to the installation and no separate payment shall be made.

B. Payment for an individual line item will not be made until all required work associated with the item has been completed and all information has been received and approved, including any required DVD's/Inspection records as required by the Specifications.

1.06 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.

1.09 FINAL PAYMENT

A. Final Payment: Will be made only for products incorporated in Work that have been inspected, and all submittals have been received, reviewed, and accepted by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Work Sequencing Plan: Submit detailed plan including all equipment, materials, labor necessary to complete installation of all new equipment and components. Plan shall show all outage times of equipment, channels, and controls. Plan shall be organized by facility and affected equipment. Plan shall be approved by Engineer prior to commencing work.
2. Photographs:
   a. Digital Images: Submit one digital USB storage media device containing images or submit through approved file sharing system. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.
   b. Video Recordings: Submit one copy on digital media or through approved file sharing system.

1.02 RELATED WORK AT SITE

A. General:

1. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
2. Include sequencing constraints specified herein as a part of Progress Schedule.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

1. Alabama One-Call:
   a. Telephone: 800-292-8525.
2. Water Works and Sanitary Sewer Board of the City of Montgomery:
   a. Engineering:
      1) Contact Person: Jared McLaughlin, P.E.
      2) Telephone: 334-206-1600.

b. Wastewater Department:
   1) Contact Person: Tim Logiotatos, P.E.
   2) Telephone: 334-206-1722.
c. Milley's Creek WPCP Maintenance:
   1) Contact Person: Joey Harrison.
   2) Telephone: 334-850-4522.

1.04 PROJECT MILESTONES AND RELEASE OF SCHEDULES OF WORK

A. Project Milestones: Generally described in the Agreement Form. Following is a description of each:

1. Substation Completion: As defined in the General Conditions of these Contract Documents.
2. Final Completion: Final Completion will be reached when all Work covered on the Drawings and in the Specifications has been completed, the Site has been returned to a condition acceptable to the Owner, and the Contractor has completely demobilized from the Project Site.

1.05 WORK SEQUENCING/CONSTRAINTS

A. All Work sequencing shall be coordinated with and approved by Engineer and Owner.

B. The information provided herein should not be relied upon by the Contractor as fully complete, comprehensive, or fully detailed. Contractor shall make their own assessment and determination of requirements that affect or may affect the progress, sequence, or cost of the Work.

C. Sequencing and constraints contained herein are contingent upon plant flowrates resulting from dry or normal weather conditions. High influent flow rates caused by periods of wet weather may alter sequencing and constraints listed below at the sole discretion of the Owner.

D. Existing gates and valves may be used in the Contractor's plan for isolation of equipment and facilities. Contractor shall field verify functionality of gates and valves utilized as part of Contractor's work sequencing prior to performing Work.

1.06 FACILITY OPERATIONS

A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified. Implementation of the work specified and as shown on the Drawings will require temporary bypass pumping to be provided and installed by the Contractor. Refer to Section 01 57 28, Temporary Flow Control.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.

E. Process or Facility Shutdown:

1. Provide 14 days advance written request for approval of need to shut down a process or facility to Owner and Engineer.
2. Power outages will be considered upon 48 hours written request to Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.

F. Install and maintain bypass facilities and temporary connections as required to provide uninterrupted flow of wastewater. Sequences other than those specified will be considered upon written request to Owner and Engineer, provided they afford equivalent continuity of operations.

G. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work.

H. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit, wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.07 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor’s operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.08 CONSTRUCTION DOCUMENTATION

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to access routes and property features, fences, roads, structures both inside and outside the Site, etc. that would be impacted by this Work.
3. Format: Digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

1.09 REFERENCE POINTS AND SURVEYS

A. Location and elevation of bench marks are shown on Drawings.

B. Contractor's Responsibilities:

1. Provide additional survey and layout required to layout the Work.
2. Notify Engineer at least 3 working days in advance of time when grade and line to be provided by Owner will be needed.
3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
4. In the event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
5. Retain professional land surveyor or civil engineer registered in state of Project who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
6. Maintain complete accurate log of survey work as it progresses as a Record Document.
7. On request of Engineer, submit documentation.
8. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
    a. Check layout, survey, and measurement work performed by others.
    b. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SALVAGE OF MATERIALS

A. The Owner has the right to any material being removed prior to the Contractor hauling off.

1. Remove material with extreme care so as not to damage for future use.
2. Promptly remove salvaged materials from Work area.
3. Store materials where instructed by Owner.

B. All materials or equipment to be removed that the Owner has not designated to be salvaged shall be disposed of by the Contractor. The Contractor is responsible for legal disposal of all removed equipment and materials.

3.02 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Refinish surfaces to provide an even finish.

C. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown.

D. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

E. Remove specimens of installed work for testing when requested by Engineer.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 7 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor's safety plan and representative.

B. Attendees will include:

1. Owner's representatives.
2. Contractor's office representative.
3. Contractor's resident superintendent.
4. Subcontractors' representatives whom Contractor may desire or Engineer may request to attend.
5. Engineer's representatives.
6. Others as appropriate.

C. Section 01 32 00, Construction Progress Documentation.

1.03 SITE COORDINATION MEETINGS

A. Engineer's representative will schedule with Owner and Contractor to coordinate weekly activities on the Project Site.

B. Brief meeting shall be held weekly during periods where the Contractor is working in and around in-service equipment and facilities.

C. Contractor should be prepared to review and discuss week's scheduled activities and coordination needs.

D. Attendees will include:

1. Milley's Creek WPCP Staff, as appropriate.
2. Contractor's Superintendent, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 PROCESS INSTRUMENTATION AND CONTROL SYSTEM (PICS) COORDINATION MEETINGS

A. Engineer will schedule meetings at Site, conducted as necessary to review specific requirements of PICS work.

B. Attendees will include:

1. Contractor.
2. Owner.
3. PICS Subcontractor/Installer.
4. Engineer's representatives.

1.06 PRE-INSTALLATION MEETINGS

A. When required in individual Specification sections, convene as Site prior to commencing the Work of that section. Pre-Installations are required for the specifications sections listed below. Other pre-installations may be required as necessary for work performed in Specifications sections other than those listed below as deemed necessary by the Engineer or Owner:

1. Section 01 57 28, Temporary Flow Control.
2. Section 02 41 00, Demolition.
3. Section 09 90 00, Painting and Coating.
4. Division 26, Electrical.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 4 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 FACILITY STARTUP MEETINGS

A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.

B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
4. Engineer's representatives.
5. Owner's operations personnel.
6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.08 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Detailed Progress Schedule:
   a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
   b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
   a. Progress Schedule: 4 legible copies.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 120 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Earthwork.
7. Specified Work sequences and construction constraints.
8. Contract Milestone and Completion Dates.
9. Owner-furnished products delivery dates or ranges of dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Format: In accordance with Article Progress Schedule.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—BAR CHART

A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, "Construction Project Planning and Scheduling Guidelines." If a conflict occurs between the AGC publication and this specification, this specification shall govern.

B. Format:

1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
2. Title Block: Show name of Project and Owner, date submitted, revision or update number, and name of scheduler.
3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Legend: Describe standard and special symbols used.

C. Contents: Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:

1. Obtaining permits, submittals for early product procurement, and long lead time items.
2. Mobilization and other preliminary activities.
3. Initial Site Work.
4. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
5. Subcontract Work.
6. Major equipment design, fabrication, factory testing, and delivery dates.
7. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
8. Sitework.
9. Concrete Work.
10. Structural steel Work.
11. Conveying systems Work.
12. Equipment Work.
13. Mechanical Work.
14. Electrical Work.
15. Instrumentation and control Work.
16. Interfaces with Owner-furnished equipment.
17. Other important Work for each major facility.
18. Equipment and system startup and test activities.
19. Project closeout and cleanup.
20. Demobilization.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected.
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

A. Direct submittals to Engineer at the following, unless specified otherwise.

B. Electronic Submittals: Submittals may be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.
5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.
7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Engineer will reject submittal that is not electronically submitted, unless specifically accepted.
9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section in format approved by Engineer.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title and Engineer's project number.
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual Specification sections.

F. Processing Time:

1. Time for review shall commence on Engineer's receipt of submittal.
2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.
   c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Engineer will keep one copy and return submittal to Contractor.

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual Specification sections.

B. Shop Drawings:

1. Copies: Six.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.

c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
d. Project-specific information drawn accurately to scale.

3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual Specifications.
2. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
   a. Manufacturer name.
   b. Model number.
   c. Material.
   d. Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
   a. Size as indicated in individual Specification section.
   b. Prepared from same materials to be used for the Work.
   c. Cured and finished in manner specified.
   d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
   a. Contractor may incorporate product(s) or implement Work covered by submittal.
   b. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.

2. Approved as Noted:
   a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   b. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.
3. Partial Approval, Resubmit as Noted:
   a. Make corrections or obtain missing portions, and resubmit.
   b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   c. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.
4. Revise and Resubmit:
   a. Contractor may not incorporate product(s) or implement Work covered by submittal.
   b. Distribution:
      1) One copy furnished Resident Project Representative.
      2) One copy retained in Engineer's file.
      3) Remaining copies returned to Contractor appropriately annotated.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Submit three copies, unless otherwise indicated in individual Specification section.
2. Refer to individual Specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual Specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual Specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

C. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

D. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual Specification section.

E. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.

F. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

G. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

H. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

I. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.

J. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

K. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

L. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   e. Provide interpretation of test results, when requested by Engineer.
   f. Other items as identified in individual Specification sections.
3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.
      3) Record of temperature and weather conditions.
      4) Identification of product and Specification section.
      5) Type and location of test, Sample, or inspection, including referenced standard or code.
      6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      8) Provide interpretation of test results, when requested by Engineer.
      9) Other items as identified in individual Specification sections.

M. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

N. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Forms: Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Jacobs

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
(ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: _____ _____ _____ _____ _____ **FROM**: _____ Contractor _____ _____ _____	Submittal No.: _____ ☐ New Submittal ☐ Resubmittal Project: _____ Project No.: _____ Specification Section No.: _____ **(Cover only one section with each transmittal)** Schedule Date of Submittal: _____

SUBMITTAL TYPE:	☐ Shop Drawing	☐ Sample	☐ Informational
	☐ Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
3. Training Session Tapes: Furnish Owner with two complete sets of tapes fully indexed and cataloged with printed label stating session and date taped.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified elsewhere.

B. Representative subject to acceptance by Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services when required by an individual Specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.

F. When specified in individual Specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of all manufacturers' representatives field notes and data to Engineer.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.
8. Additional requirements may be specified elsewhere.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.

B. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:

1. Title and objectives.
2. Recommended attendees (e.g., managers, engineers, operators, maintenance).
3. Course description, outline of course content, and estimated class duration.
4. Format (e.g., lecture, self-study, demonstration, hands-on).
5. Instruction materials and equipment requirements.
6. Resumes of instructors providing the training.

D. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

E. Taping of Training Sessions:

1. Furnish audio and color video taping of prestartup and post-startup instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.
2. Video training tapes shall be produced by a qualified, professional video production company.

3. Use digital format, suitable for playback on standard equipment available commercially in the United States.
4. Include only one training session on each tape, or on a single track of a tape.

3.04 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Form: Manufacturer's Certificate of Compliance.
2. Form: Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:

PRODUCT, MATERIAL, OR SERVICE SUBMITTED:

PROJECT NAME:

PROJECT NO:

Comments:_____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer:_____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO:_____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments:_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures;
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
3. Constitute or imply acceptance; or
4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Engineer.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.

5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.03 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
   a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
   b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
   c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.

d. Perform prior to beginning Work on each definable feature of Work:
   1) Review applicable Contract Specifications.
   2) Review applicable Contract Drawings.
   3) Verify that all materials and/or equipment have been tested, submitted, and approved.
   4) Verify that provisions have been made to provide required control inspection and testing.
   5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
   6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
   7) Review the appropriate activity hazard analysis to verify safety requirements are met.
   8) Review procedures for constructing the Work, including repetitive deficiencies.
   9) Document construction tolerances and workmanship standards for that phase of the Work.
   10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
   a. Accomplish at the beginning of a definable feature of Work:
      1) Notify Owner at least 48 hours in advance of beginning the initial phase.
      2) Perform prior to beginning Work on each definable feature of Work:
         a) Review minutes of the preparatory meeting.
         b) Check preliminary Work to verify compliance with Contract requirements.
         c) Verify required control inspection and testing.
         d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
         e) Resolve all differences.
         f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3. Follow-up Phase:
   a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
   b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
   c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.04 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.05 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
   a. Verify testing procedures comply with contract requirements.
   b. Verify facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.
d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
e. Documentation:
    1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
    2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
    3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.
    4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
    5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.06 COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.

3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2021 IBC and is in addition to and supplements requirements included in Statement of Special Inspections shown in supplement located at end of this section.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. International Code Council (ICC):
   a. International Building Code (IBC).
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03 DEFINITIONS

A. Agencies and Personnel:

1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

B. Statement of Special Inspections: Detailed written procedure contained in supplement located at end of this section establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

C. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

D. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical and Plumbing Component Supports: Structural members or assemblies which transmit loads and forces from mechanical or plumbing equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections provided in supplement located at the end of this section.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

1.04 SUBMITTALS

A. Informational Submittals:

1. Contractor’s Statement of Responsibility: Form shall be completed by entity responsible for construction of main wind-force-resisting system, and main seismic-force-resisting system listed in Statement of Special Inspections. Refer to Article Supplements located at end of section.
2. Fabricator’s Certificate of Compliance: Form shall be completed by entity responsible for shop fabrication of structural load-bearing members and assemblies. Refer to Article Supplements located at end of section.

1.05 STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Designated Systems for Inspection:

1. None required.
2. Wind-force-resisting systems designated under IBC Section 1705: None required.
3. Architectural, Plumbing, Mechanical, and Electrical Components subject to Special Inspection under IBC Section 1705.13.5 and 1705.13.6 for Seismic Resistance: None required.

B. Statement of Special Inspections:

1. As included in supplement located at the end of this section and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
   a. Special Inspection and testing required by IBC Section 1705 and other applicable sections and referenced standards therein.
   b. Type and frequency of Special Inspection required.
   c. Type and frequency of testing required.
   d. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
   e. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner.
   f. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Contractor, building official, and Owner.

C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction’s (AHJ) approved, qualified inspection staff. Owner will secure and pay for services of agency to perform Special Inspection and associated testing.

D. Code required Special Inspection with associated testing and Professional Observation, as provided in Statement of Special Inspections in supplement located at the end of this section and further provided in this section, is for benefit of Owner and does not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.

2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
3. Constitute or imply acceptance.
4. Affect continuing rights of Owner after acceptance of completed Work.

E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing and Observation when Work is not ready at time identified by Contractor and Special Inspectors and Professional Observer are onsite, but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing and Professional Observation by Special Inspectors and Professional Observers required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and observation and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.

B. Provide access to shop or Site for Special Inspection and Testing and Professional Observation requirements.

C. Notify Engineer in advance of required Special Inspection and Professional Observation no later than 48 hours prior to date of Special Inspection and Professional Observation.

D. Provide access for Special Inspector to construction documents.

E. Retain special inspection records on-site to be readily available for review.

F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.

G. Submit Fabricator's Certificates of Compliance for approved fabricators.

H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:

1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.
2. Providing storage space for the Special Inspector's exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
3. Providing the Special Inspector with access to all approved submittals.
4. Providing security and protection of samples and test equipment at the Project Site.
5. Provide samples of materials to be tested in required quantities.

I. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

J. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:

1. Schedule inspections for either during or at completion of their placement or a combination or both.
2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.02 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Contractor's Statement of Responsibility.
2. Fabricator's Certificate of Compliance.
3. Statement of Special Inspections.
4. Tables 1 through 6.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

_____
(Project)

_____
(Name of Contracting Company)

_____
(Business Address)

(_____) _____ (_____) _____
(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing requirements contained in Contract Documents for this Project for wind and seismic force-resisting systems as listed in Statement of Special Inspections in supplement located at the end of this section, and that:

1. I, (We) aware of the systems and the requirements of the special inspection and acknowledge our responsibility in the implementation of the Statement of Special Inspections for the construction of the following systems:

Facility	Specification	Lateral Force-Resisting System
Platform	05 12 00	Structural steel system not specifically detailed for seismic resistance

2. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.

3. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Statement of Special Inspections for Project are attached to this statement.

4. I, (We) will provide 48-hour notification to Engineer and approved inspection agency as required for structural tests and Special Inspection for Project.

5. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

_____

_____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: _____

FABRICATOR'S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2.5 of 2021 IBC must submit Fabricator's Certificate of Compliance at the completion of fabrication.

_____

(Project)

_____

(Fabricator's Name)

_____

(Business Address)

_____

(Certification or Approval Agency)

_____

(Certification Number)

_____

(Date of Last Audit or Approval)

Description of structural members and assemblies that have been fabricated:

_____

_____

_____

_____

_____

I hereby certify that items described above were fabricated in strict accordance with approved construction documents.

_____

(Name and Title) type or print

_____

(Signature and Date)

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

STATEMENT OF SPECIAL INSPECTIONS

GENERAL NOTES

1. THE STATEMENT OF SPECIAL INSPECTIONS PROVIDE PROJECT COMPLIANCE WITH THE PROVISIONS OF THE 2021 INTERNATIONAL BUILDING CODE (IBC) CHAPTER 17 FOR SPECIAL INSPECTION, STRUCTURAL OBSERVATION, AND TESTING FOR WIND AND SEISMIC RESISTANCE AS APPLICABLE. EXCEPT WHERE OTHERWISE NOTED, THIS INSPECTION IS OWNER FURNISHED.
2. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 1.
3. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR STRUCTURAL COMPONENTS, REGARDLESS OF WIND OR SEISMIC DESIGN CATEGORIES, ARE CONTAINED IN TABLE 2. STANDARD TESTING REQUIREMENTS FOR STRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 3.
4. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, OR F ARE CONTAINED IN TABLE 4. ADDITIONAL TESTING REQUIREMENTS FOR STRUCTURAL RESISTANCE ARE CONTAINED IN TABLE 6.
5. CONTAINED IN TABLE 5 ARE PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES SUBJECT TO BASIC WIND SPEEDS V:
    A. IN EXPOSURE CATEGORY B, ‘V’ IS EQUAL OR EXCEEDS 150 MPH; OR
    B. IN EXPOSURE CATEGORY C OR D, ‘V’ IS EQUAL OR EXCEEDS 140 MPH.
6. FOR ADDITIONAL REQUIREMENTS, REFER TO SPECIFICATION SECTION 01 45 33, SPECIAL INSPECTION, OBSERVATION, AND TESTING. THESE INCLUDE:
    A. CONTRACTOR’S REQUIREMENTS TO PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS, AND TO PROVIDE NOTICE OF REQUIRED INSPECTIONS AND STRUCTURAL OBSERVATION.
    B. CONTRACTOR’S STATEMENT OF RESPONSIBILITY FOR WORK TO BE PERFORMED ON SYSTEMS DESIGNATED UNDER THE STATEMENT OF SPECIAL INSPECTIONS FOR WIND OR SEISMIC RESISTANCE.
    C. DEFINITIONS AND TERMINOLOGY USED IN THIS STATEMENT OF SPECIAL INSPECTIONS.

SPECIAL INSPECTION

1. SPECIAL INSPECTION WILL BE IN ACCORDANCE WITH IBC SECTIONS 1704 AND 1705 TOGETHER WITH LOCAL AND STATE AMENDMENTS. REFER TO THE FOLLOWING TABLES FOR PROJECT SPECIFIC INSPECTION TYPES AND FREQUENCIES.
2. SPECIAL INSPECTIONS WILL BE PROVIDED BY A CERTIFIED OR QUALIFIED INSPECTOR AND ASSOCIATED TESTING WILL BE PERFORMED BY AN APPROVED ACCREDITED INDEPENDENT AGENCY. THE OWNER WILL SECURE AND PAY FOR THE SERVICES OF THE AGENCY TO PERFORM ALL SPECIAL INSPECTION AND ASSOCIATED TESTS. INSPECTORS FOR EACH SYSTEM AND MATERIAL WILL BE INTERNATIONAL CODE COUNCIL (ICC) CERTIFIED OR OTHERWISE APPROVED BY THE BUILDING OFFICIAL.
3. THE SPECIAL INSPECTOR WILL OBSERVE THE INDICATED WORK FOR COMPLIANCE WITH THE APPROVED CONTRACT DOCUMENTS AND SUBMIT RECORDS OF INSPECTION. ALL DISCREPANCIES WILL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE CONTRACTOR FOR CORRECTION.
4. SPECIAL INSPECTION AND ASSOCIATED TESTING REPORTS WILL BE SUBMITTED TO THE ENGINEER, CONTRACTOR, BUILDING OFFICIAL, AND OWNER WITHIN ONE WEEK OF INSPECTION OR WITHIN ONE WEEK OF TEST COMPLETION. INSPECTIONS FOR WHICH REPORTING WILL BE REQUIRED ARE NOTED IN THE FOLLOWING TABLES.
5. AT THE CONCLUSION OF CONSTRUCTION, A FINAL REPORT DOCUMENTING REQUIRED SPECIAL INSPECTIONS AND CORRECTION OF PREVIOUSLY NOTED DISCREPANCIES WILL BE SUBMITTED.

GEOTECHNICAL OBSERVATION

1. ALL FOUNDATION BEARING SURFACES SHALL BE INSPECTED BY GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF REINFORCING STEEL. ADDITIONAL SPECIAL INSPECTION REQUIREMENTS ARE LISTED IN TABLE 1.
2. GEOTECHNICAL TESTING REQUIREMENTS ARE LISTED IN TABLE 3.

STRUCTURAL OBSERVATION

1. STRUCTURAL OBSERVATION WILL BE IN ACCORDANCE WITH IBC SECTION 1704.6 TOGETHER WITH LOCAL AND STATE AMENDMENTS.

2. ONSITE STRUCTURAL OBSERVATION WILL BE PERFORMED FOR EACH IDENTIFIED SEISMIC FORCE- OR WIND FORCE-RESISTING SYSTEM, INCLUDING FOUNDATIONS AND CONNECTIONS. REFER TO THE GENERAL STRUCTURAL NOTES, DRAWING FOR THE BASIC SEISMIC AND WIND FORCE-RESISTING SYSTEMS FOR THE STRUCTURES INCLUDED IN THE WORK.
3. STRUCTURAL OBSERVATION WILL BE PERFORMED BY A REGISTERED PROJECT DESIGN PROFESSIONAL FOR GENERAL CONFORMANCE TO THE APPROVED CONSTRUCTION DOCUMENTS. STRUCTURAL OBSERVATION DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY FOR ANY REQUIRED SPECIAL INSPECTIONS OR INSPECTIONS BY THE BUILDING OFFICIAL.
4. STRUCTURAL OBSERVATION REPORTS, NOTING ANY DEFICIENCIES IN OBSERVED CONSTRUCTION, WILL BE DELIVERED TO THE CONTRACTOR, BUILDING OFFICIAL, AND OWNER FOLLOWING EACH OBSERVATION. THE CONTRACTOR WILL BE NOTIFIED ONSITE OR BY PHONE OR E-MAIL WITHIN 24 HOURS UPON FINDING DEFICIENCIES.
5. AT THE CONCLUSION OF CONSTRUCTION, A WRITTEN STATEMENT WILL BE PROVIDED TO VERIFY THAT THE STRUCTURAL OBSERVATION SITE VISITS WERE MADE AND WHETHER THERE REMAIN ANY STRUCTURAL DEFICIENCIES THAT HAVE NOT BEEN RESOLVED.
6. STRUCTURAL OBSERVATION WILL INCLUDE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM AT SIGNIFICANT CONSTRUCTION STAGES AND AT COMPLETION OF THE STRUCTURAL SYSTEM FOR EACH STRUCTURE CONTAINED IN THE WORK. THE CONTRACTOR SHALL SCHEDULE AND FACILITATE STRUCTURAL OBSERVATION, INCLUDING THE ELEMENTS DESCRIBED IN THE STRUCTURAL OBSERVATION TABLES (ATTACHED).

SPECIAL INSPECTIONS FOR WIND RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR WIND RESISTANCE IN ACCORDANCE WITH IBC SECTION 1705.12 ARE NOT APPLICABLE TO THIS PROJECT**.**

SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

1. SPECIAL INSPECTIONS REQUIREMENTS FOR SEISMIC RESISTANCE IN ACCORDANCE WITH IBC SECTION 1705.13 ARE NOT APPLICABLE TO THIS PROJECT.

Statement of Special Inspections Prepared by:

_____
Type or Print Name

_____
Signature

_____
Date

Preparer's Seal

TABLE 1
REQUIRED NON-STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM OR MATERIAL	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
GEOTECHNICAL						
1. SOILS:						
A. VERIFY MATERIALS BELOW SHALLOW FOUNDATIONS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY	1705.6, 1803.5.8, 1803.5.9, 1804.6, 1804.7	SECTION 31 23 13, SUBGRADE PREPARATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	
B. VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL	1705.6	SECTION 31 23 16, EXCAVATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	
C. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS	1705.6	SECTION 31 23 23, FILL AND BACKFILL	X			SEE TABLE 3 FOR GRADATION TEST REQUIREMENTS
D.VERIFY USE OF PROPER MATERIALS, DENSITIES, AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF COMPACTED FILL	1705.6, 1803.5.8	SECTION 31 23 23, FILL AND BACKFILL		X		SEE TABLE 3 FOR DENSITY TEST REQUIREMENTS
E. PRIOR TO PLACEMENT OF COMPACTED FILL, INSPECT SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY	1705.6	SECTION 31 23 13, SUBGRADE PREPARATION	X		PROFESSIONAL OBSERVATION BY GEOTECHNICAL ENGINEER	SEE TABLE 3 FOR DENSITY TEST **[AND PROOF ROLLING]** REQUIREMENTS
GENERAL						
1. CONSTRUCTION MATERIALS AND SYSTEMS THAT ARE ALTERNATIVES TO MATERIALS AND SYSTEMS PRESCRIBED BY CODE	1705.1.1 ITEM 1		X			
2. UNUSUAL DESIGN APPLICATION OF CODE MATERIALS	1705.1.1 ITEM 2			X		
3. INSTALLATION OF MATERIALS THAT REQUIRE ADDITIONAL MANUFACTURER'S INSTRUCTIONS BEYOND CODE REQUIREMENTS	1703.4.2, 1705.1.1 ITEM 3	ICC-ES EVALUATION REPORTS		X		
STRUCTURAL						
SEE TABLE 2.						

NOTES:
1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
CONCRETE						
1. INSPECT REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS, AND VERIFY PLACEMENT	1705.3, 1908.4	ACI 318: Ch. 20, 25.2, 25.3, 26.6.1-26.6.3	X			SEE TABLE 6 FOR REINFORCING STEEL TESTING
2. INSPECTION OF REINFORCING STEEL WELDING					N/A	
3. INSPECT ANCHORS CAST IN CONCRETE	1705.3	ACI 318: 17.8.2	X			
4. INSPECT ANCHORS POST-INSTALLED IN HARDENED CONCRETE MEMBERS		ACI 318: 26.7				
A. ADHESIVE ANCHORS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED OREIENTATIONS TO RESIST SUSTAINED TENSION LOADS	1705.3	ACI 318: 17.8.2.4, ICC-ES EVALUATION REPORTS		X		
B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS NOT DEFINED IN 4A.	1705.3	ACI 318: 17.8.2, ICC-ES EVALUATION REPORTS	X			
5. VERIFY USE OF REQUIRED DESIGN MIX	1705.3, 1904.1, 1904.2, 1908.2, 1908.3	ACI 318: Ch. 19, 26.4.3, 26.4.4	X			
6. PRIOR TO CONCRETE PLACEMENT, FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE	1705.3, 1908.10	ASTM C 172, ASTM C 31, ACI 318: 26.5, 26.12		X		SEE TABLE 3 FOR CONCRETE TEST REQUIREMENTS
7. INSPECT CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES	1705.3, 1908.6, 1908.7, 1908.8	ACI 318: 26.5.1.1, 26.5.2.1		X		
8. VERIFY MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES	1705.3, 1908.9	ACI 318: 26.5.3-26.5.5	X			
9. INSPECT PRESTRESSED CONCRETE:					N/A	

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
10. INSPECT ERECTION OF PRECAST CONCRETE MEMBERS	1705.3	ACI 318: Ch. 26.9	X		N/A	
11. VERIFY IN-SITU CONCRETE STRENGTH, PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORING AND FORMS FROM BEAMS AND STRUCTURAL SLABS	1705.3	ACI 318: 26.11.2	X		N/A	
12. INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED	1705.3	ACI 318: 26.11.1.2	X			
13. INSPECTION OF WATERSTOPS FOR PROPER SHAPE, LOCATION, JOINT QUALITY, AND SURROUNDING CONCRETE PLACEMENT		ACI: 26.5.6.2	X		N/A	
14. VERIFY PROPER INSTALLATION OF MECHANICAL REINFORCING SPLICES AND CONNECTIONS	1705.1.1 ITEM 3, 1705.3	ICC-ES EVALUATION REPORTS	X			
STRUCTURAL STEEL						
1. MATERIAL VERIFICATION OF STRUCTURAL STEEL:						
A. IDENTIFICATION MARKINGS TO CONFORM TO AISC 360	1705.2.1, 2203.1	Applicable ASTM Material Standards	X			
B. MANUFACTURER'S CERTIFIED TEST REPORTS	1705.2.1	AISC 360: Sec. N3.2, N5.2	X			
2. PRIOR TO BOLTING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:						
A. MANUFACTURER'S CERTIFICATIONS AVAILABLE FOR FASTENER MATERIALS	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6 RCSC: Sec. 2.1, 9.1		X		
B. FASTENERS MARKED IN ACCORDANCE WITH ASTM REQUIREMENTS	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6 Applicable ASTM Material Standards	X			

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
C. CORRECT FASTENERS SELECTED FOR THE JOINT DETAIL (GRADE, TYPE, BOLT LENGTH IF THREADS ARE TO BE EXCLUDED FROM THE SHEAR PLANE)	1705.2.1	AISC 360: Sec. N3.2, N5.2, N5.6	X			
D. CORRECT BOLTING PROCEDURE SELECTED FOR JOINT DETAIL	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 4	X			
E. CONNECTING ELEMENTS, INCLUDING THE APPROPRIATE FAYING SURFACE CONDITION AND HOLE PREPARATION, IF SPECIFIED, MEET APPLICABLE REQUIREMENTS	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 3.2, 4	X			
F. PRE-INSTALLATION VERIFICATION TESTING BY INSTALLATION PERSONNEL OBSERVED AND DOCUMENTED FOR FASTENER ASSEMBLIES AND METHODS USED	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 7	X			
G. PROTECTED STORAGE PROVIDED FOR BOLTS, NUTS, WASHERS AND OTHER FASTENER COMPONENTS	1705.2.1	AISC 360: Sec. N5.6 RCSC: Sec. 2.2	X			
3. VERIFY DURING BOLTING:						
A. FASTENER ASSEMBLIES PLACED IN ALL HOLES AND WASHERS (IF REQUIRED) AND NUTS ARE POSITIONED AS REQUIRED	1705.2.1	AISC 360: Sec. N5.6	X			
B. JOINT BROUGHT TO SNUG-TIGHT CONDITION PRIOR TO THE PRETENSIONING OPERATION	1705.2.1	AISC 360: Sec. N5.6	X			
C. FASTENER COMPONENT NOT TURNED BY THE WRENCH PREVENTED FROM ROTATING	1705.2.1	AISC 360: Sec. N5.6	X			

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
D. FASTENERS ARE PRETENSIONED IN ACCORDANCE WITH THE RCSC SPECIFICATION, PROGRESSING SYSTEMATICALLY FROM THE MOST RIGID POINT TOWARD THE FREE EDGES	1705.2.1	AISC 360: Sec. N5.6	X			SEE TABLE 3 FOR TESTING OF HIGH-STRENGTH BOLTING
4. PRIOR TO WELDING, VERIFY THAT THE FOLLOWING ARE IN COMPLIANCE:						
A. APPROVED WELDER QUALIFICATION RECORDS AND CONTINUITY RECORDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
B. APPROVED WELDING PROCEDURE SPECIFICATIONS (WPS) AVAILABLE TO WELDERS AND WELDING INSPECTOR(S)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
C. MANUFACTURER CERTIFICATIONS FOR WELDING CONSUMABLES AVAILABLE	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
D. MATERIAL IDENTIFICATION (TYPE/GRADE)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
E. WELDER IDENTIFICATION SYSTEM	1705.2.1	AISC 360: Sec. N5.4	X			
F. FIT-UP OF WELDS (INCLUDING JOINT GEOMETRY)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	REQUIREMENTS OF SPEC. SECTION 05 05 23
G. CONFIGURATION AND FINISH OF ACCESS HOLES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	REQUIREMENTS OF SPEC. SECTION 05 05 23
5. VERIFY DURING WELDING:						
A. CONTROL AND HANDLING OF WELDING CONSUMABLES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
B. NO WELDING OVER CRACKED TACK WELDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
C. ENVIRONMENTAL CONDITIONS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
D. COMPLIANCE WITH WPS REQUIREMENTS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	ALSO SEE REQUIREMENTS OF SPEC. SECTION 05 05 23 AND TABLE 3 FOR STRUCTURAL STEEL TEST REQUIREMENT
E. WELDING TECHNIQUES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
F. PLACEMENT AND INSTALLATION OF STEEL HEADED STUD ANCHORS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1		X		
6. AFTER WELDING, VERIFY THE FOLLOWING:						
A. WELDS CLEANED	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
B. SIZE, LENGTH AND LOCATION OF WELDS	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	
C. WELDS MEET VISUAL ACCEPTANCE CRITERIA	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X		NOTE 2	ALSO SEE REQUIREMENTS OF SPEC. SECTION 05 05 23
D. ARC STRIKES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
E. K-AREA	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
F. BACKING REMOVED AND WELD TABS REMOVED (IF REQUIRED)	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
G. REPAIR ACTIVITIES	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
H. NO PROHIBITED WELDS HAVE BEEN ADDED WITHOUT THE APPROVAL OF THE EOR	1705.2.1	AISC 360: Sec. N5.4 AWS D1.1	X			
I. NONDESTRUCTIVE WELDING INSPECTION	1705.2	AISC 360: Sec. N5.5 AWS D1.1	X		NOTE 2	ALSO SEE REQUIREMENTS OF SPEC. SECTION 05 05 23
7. INSPECTION OF GALVANIZED STRUCTURAL STEEL MAIN MEMBERS FOR CRACKS SUBSEQUENT TO GALVANIZING	1705.2.1	AISC 360: Sec. N5.7	X			
8. INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE:						

TABLE 2
REQUIRED STRUCTURAL SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
A. DETAILS SUCH AS BRACING AND STIFFENING	1705.2.1	AISC 360: Sec. N5.8	X			
B. MEMBER LOCATIONS	1705.2.1	AISC 360: Sec. N5.8	X			
C. APPLICATION OF JOINT DETAILS AT EACH CONNECTION	1705.2.1	AISC 360: Sec. N5.8	X			
ALUMINUM						
1. MATERIAL VERIFICATION OF ALUMINUM:						
A. IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS	1705.1.1 ITEM 2		X			
B. MANUFACTURERS' CERTIFIED MILL TEST REPORTS	1705.1.1 ITEM 2		X			
2. INSPECTION OF WELDING:						
A. NONDESTRUCTIVE INSPECTION	1705.1.1 ITEM 2	AWS D1.2	X		NOTE 2	ALSO SEE REQUIREMENTS OF SPEC. SECTION 05 05 23

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.

2. VISUAL INSPECTION IS THE RESPONSIBILITY OF THE CONTRACTOR'S WELDING INSPECTOR(S) AND IS NOT CONSIDERED SPECIAL INSPECTION. CONTRACTOR MUST PROVIDE A QUALIFIED WELDING INSPECTOR TO OVERSEE CONTRACTOR'S WELDING OPERATIONS, AS REQUIRED BY SPECIFICATION SECTION 05 05 23 AND REFERENCED WELDING CODES.

3. SPECIAL INSPECTOR TO OBSERVE ON AN INTERMITTENT BASIS SUFFICIENT TO CONFIRM THAT THE WORK HAS BEEN PERFORMED IN ACCORDANCE WITH THE APPLICABLE DOCUMENTS. OPERATIONS NEED NOT BE DELAYED PENDING THESE INSPECTIONS.

4. N/A INDICATES ITEM NOT APPLICALBE TO PROJECT.

TABLE 3
TESTING FOR REQUIRED SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2021 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
GEOTECHNICAL						
COMPACTED FILL	GRADATION	ASTM C117, C136	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
COMPACTED FILL	COMPACTION	ASTM **D698 or D1557 per direction of Geotechnical engineer.**	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
COMPACTED FILL	DENSITY	ASTM **D1556 or D6938 per direction of Geotechnical engineer.**	1705.6	SECTION 31 23 23, FILL AND BACKFILL	OWNER'S TESTING AGENCY	
PREPARED SUBGRADE	DENSITY	ASTM **D698 or D1557 per direction of Geotechnical engineer.**	1705.6	SECTION 31 23 13, SUBGRADE PREPARATION	OWNER'S TESTING AGENCY	
CONCRETE						
CONCRETE	STRENGTH	ASTM C39	1705.3	ONCE EACH DAY, BUT NOT LESS THAN ONE SAMPLE FOR EACH 150 CUBIC YARDS OR 5,000 SFT OF WALLS OR SLABS PLACED	OWNER'S TESTING AGENCY	

TABLE 3
TESTING FOR REQUIRED SPECIAL INSPECTION
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2021 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
CONCRETE	SLUMP	ASTM C143, C94	1705.3	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
CONCRETE	AIR CONTENT	ASTM C231, C94	1705.3	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
CONCRETE	TEMPERATURE	ASTM C1064	1705.3	ONE SAMPLE PER STRENGTH TEST	OWNER'S TESTING AGENCY	
STEEL						
HIGH-STRENGTH BOLTING	PRE-INSTALLATION VERIFICATION TESTING OF PRETENSIONED BOLTS	RCSC SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH STRENGTH BOLTS, Sec. 7	1705.2	3 FASTENER ASSEMBLIES OF EACH COMBINATION OF DIAMETER, LENGTH, GRADE AND LOT	OWNER'S TESTING AGENCY	
STRUCTURAL STEEL	ULTRASONIC OR RADIOGRAPHIC NONDESTRUCTIVE TESTING	AWS D1.1	1705.2	SECTION 05 05 23, WELDING	OWNER'S TESTING AGENCY	PERFORM RT OR UT ON GROOVE WELDS

TABLE 4

REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33

The Seismic Design Category (SDC) for this Project is B.

SYSTEM	INSPECTION REQUIRED FOR FOLLOWING SEISMIC DESIGN CATEGORIES	2018 IBC CODE REFERENCE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
ELECTRICAL						
INSTALLATION OF ANCHORAGE OF ELECTRICAL EQUIPMENT FOR EMERGENCY OR STANDBY POWER SYSTEMS	"C" AND ABOVE	1705.12.6 ITEM 1	X		NOTES 2 & 3	
INSTALLATION OF EQUIPMENT USING COMBUSTIBLE ENERGY SOURCES AND PIPING SYSTEMS PROVIDING SUPPLY	"C" AND ABOVE	1705.12.6 ITEM 3	X		NOTES 2 & 3	
INSTALLATION OF ANCHORAGE OF ALL OTHER ELECTRICAL EQUIPMENT	"E" AND ABOVE	1705.12.6 ITEM 2	X		NOTES 2 & 3	
INSTALLATION OF OTHER SEISMIC SUPPORTS FOR DESIGNATED ELECTRICAL SYSTEMS AND THEIR COMPONENTS	"B" AND ABOVE	1705.13.2	X		NOTES 2 & 3	SEE TABLE 6
PROCESS MECHANICAL						
INSTALLATION OF PIPING SYSTEMS MEANT TO CARRY HAZARDOUS MATERIALS AND ITS ASSOCIATED MECHANICAL UNITS	"C" AND ABOVE	1705.12.6 ITEM 3	X			
INSTALLATION OF OTHER SEISMIC SUPPORTS FOR DESIGNATED MECHANICAL SYSTEMS AND THEIR COMPONENTS	"B" AND ABOVE	1705.13.2	X		NOTES 2 & 3	SEE TABLE 6
BUILDING MECHANICAL AND PLUMBING						
INSTALLATION OF PIPING SYSTEMS MEANT TO CARRY HAZARDOUS MATERIALS AND ITS ASSOCIATED MECHANICAL UNITS	"C" AND ABOVE	1705.12.6 ITEM 3	X			
INSTALLATION AND ANCHORAGE OF HVAC DUCTWORK THAT WILL CONTAIN HAZARDOUS MATERIALS	"C" AND ABOVE	1705.12.6 ITEM 4	X			

TABLE 4

REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33

The Seismic Design Category (SDC) for this Project is B.

SYSTEM	INSPECTION REQUIRED FOR FOLLOWING SEISMIC DESIGN CATEGORIES	2018 IBC CODE REFERENCE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
INSTALLATION OF VIBRATION ISOLATION SYSTEMS WHERE THE CONSTRUCTION DOCUMENTS REQUIRE A NOMINAL CLEARANCE OF 0.25 INCHES OR LESS BETWEEN THE EQUIPMENT SUPPORT FRAME AND RESTRAINT	"C" AND ABOVE	1705.12.6 ITEM 5	X		NOTES 2 & 3	
INSTALLATION OF FIRE PROTECTION SPRINKLER SYSTEM	"C" AND ABOVE	1705.12.6 ITEM 6	X		NOTE 5	
INSTALLATION OF OTHER SEISMIC SUPPORTS FOR DESIGNATED MECHANICAL SYSTEMS AND THEIR COMPONENTS	"B" AND ABOVE	1705.13.2	X		NOTES 2 & 3	SEE TABLE 6
STRUCTURAL						
STRUCTURAL STEEL INSPECTION OF SEISMIC-FORCE-RESISTING SYSTEMS	"B" AND ABOVE	1705.12.1.1, AISC 341		X		SEE TABLE 6 FOR STRUCTURAL STEEL TESTING
INSPECTION OF STRUCTURAL STEEL ELEMENTS INCLUDING STRUTS, COLLECTORS, CHORDS AND FOUNDATION ELEMENTS	"B" AND ABOVE	1705.12.1.2, AISC 341		X		SEE TABLE 6 FOR STRUCTURAL STEEL TESTING
FABRICATION AND INSTALLATION OF ISOLATOR UNITS AND ENERGY DISSIPATION DEVICES PART OF SEISMIC ISOLATION SYSTEMS	"B" AND ABOVE	1705.12.8	X			SEE TABLE 6

NOTES:
1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING THE INSPECTED WORK
2. TESTING OF SYSTEMS AND THEIR ANCHORAGE SHALL BE IN CONFORMANCE WITH 2018 IBC SECTION 1705.13.2.
3. CERTIFICATION OF SYSTEMS AND THEIR ANCHORAGE SHALL BE IN CONFORMANCE WITH 2018 IBC SECTION 1705.13.3.
4. NOT REQUIRED IF SHEATHING IS GYPSUM BOARD OR FIBERBOARD OR IF SHEATHING IS WOOD STRUCTURAL PANEL OR STEEL SHEETS

TABLE 4

REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33

The Seismic Design Category (SDC) for this Project is B.

SYSTEM	INSPECTION REQUIRED FOR FOLLOWING SEISMIC DESIGN CATEGORIES	2018 IBC CODE REFERENCE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION

ON ONE SIDE OF PANEL OR DIAPHRAGM ONLY AND THE FASTENER SPACING IS MORE THAN 4 INCHES.
5. SPECIAL INSPECTOR TO VERIFY THAT CLEARANCES AROUND AUTOMATIC FIRE SPRINKLER SYSTEMS ARE SUFFICIENT SUCH THAT FAILURE OF AN ARCHITECTURAL, MECHANICAL, OR ELECTRICAL COMPONENT WILL NOT CAUSE FAILURE OF THE SPRINKLER SYSTEM AND THAT CLEARANCES ARE NOT LESS THAN 3 INCHES, INCLUDING TO STRUCTURAL MEMBERS NOT SUPPORTING THE SYSTEM.

TABLE 5

REQUIRED SPECIAL INSPECTION FOR WIND RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO SPECIFICATION SECTION 01 45 33

The Basic Wind Speed (3-second-gust) for this Project is 119 mph.
The Wind Exposure is Category C.

SYSTEM	2018 IBC CODE REFERENCE	STANDARD OR CODE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS
STRUCTURAL					
FIELD GLUING OPERATIONS OF ELEMENTS OF THE STRUCTURAL WOOD MAIN WIND-FORCE-RESISTING SYSTEM	1705.11.1			X	NOTE 2
NAILING, BOLTING, ANCHORING, AND OTHER FASTENING IN STRUCTURAL WOOD MAIN WIND-FORCE-RESISTING SYSTEMS INCLUDING DRAG STRUTS, BRACES, AND HOLD-DOWNS	1705.11.1		X		NOTE 2
FASTENING OF WOOD SHEAR WALLS, SHEAR PANELS, AND DIAPHRAGMS WHEN THE FASTENER SPACING <= 4 INCHES AT PANEL EDGES	1705.11.1		X		NOTE 2
COLD FORMED STEEL LIGHT-FRAMED CONSTRUCTION: WELDING, SCREW ATTACHMENT, BOLTING, ANCHORING AND OTHER FASTENINGS WITHIN THE MAIN WIND FORCE-RESISTING SYSTEM INCLUDING SHEAR WALLS, BRACES, DIAPHRAGMS, COLLECTORS (DRAG STRUTS), AND HOLD-DOWNS	1705.11.2		X		NOTES 2 AND 3
ARCHITECTURAL					
FASTENING OF ROOF COVERING, ROOF DECK AND ROOF FRAMING CONNECTIONS	1705.11.3		X		NOTE 2
FASTENING OF EXTERIOR WALL CLADDING AND WALL CONNECTIONS TO ROOF AND FLOOR DIAPHRAGMS AND FRAMING	1705.11.3		X		NOTE 2

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING THE INSPECTED WORK.

2. SPECIAL INSPECTIONS FOR WIND RESISTANCE ARE REQUIRED FOR BUILDINGS AND STRUCTURES CONSTRUCTED IN WIND EXPOSURE CATEGORY B, WHERE THE 3-SECOND-GUST ALLOWABLE STRESS DESIGN WIND SPEED IS 120 MPH OR GREATER, OR IN WIND EXPOSURE CATEGORIES C OR D, WHERE THE 3-SECOND-GUST ALLOWABLE STRESS DESIGN WIND SPEED IS 110 MPH OR GREATER.

3. NOT REQUIRED IF SHEATHING IS GYPSUM BOARD OR FIBERBOARD, OR IF SHEATHING IS WOOD STRUCTURAL PANEL OR STEEL SHEETS ON ONE SIDE OF PANEL OR DIAPHRAGM ONLY AND THE FASTENER SPACING IS MORE THAN 4 INCHES.

TABLE 6
TESTING FOR SEISMIC RESISTANCE
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2018 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
STEEL						
TEST IN ACCORDANCE WITH THE QUALITY ASSURANCE REQUIREMENTS OF AISC 341	NONDESTRUCTIVE TESTING	AISC 341 AWS D1.8	1705.13.1.1, 1705.13.1.2	CONTINUOUS	OWNER'S SPECIAL INSPECTOR	
ULTRASONIC (UT) NONDESTRUCTIVE TESTING OF GROOVE WELDS	NONDESTRUCTIVE TESTING	AISC 341 AWS D1.8	1705.13.1.1, 1705.13.1.2	CONTINUOUS	OWNER'S SPECIAL INSPECTOR	SEE SECTION 05 05 23, WELDING
MAGNETIC PARTICLE (MT) OR LIQUID PENETRANT (PT) NONDESTRUCTIVE TESTING	NONDESTRUCTIVE TESTING	AISC 341 AWS D1.8	1705.13.1.1, 1705.13.1.2	CONTINUOUS	OWNER'S SPECIAL INSPECTOR	SEE SECTION 05 05 23, WELDING
BASE METAL THICKER THAN 1.5 INCHES WHERE SUBJECT TO THROUGH-THICKNESS WELD SHRINKAGE STRAINS	ULTRASONIC TESTING	AISC 341 AWS D1.8	1705.13.1.1, 1705.13.1.2	CONTINUOUS	OWNER'S SPECIAL INSPECTOR	SEE SECTION 05 05 23, WELDING

TABLE 6
TESTING FOR SEISMIC RESISTANCE
REFER TO SPECIFICATION SECTION 01 45 33

MATERIAL	TYPE OR SCOPE	STANDARD	2018 IBC CODE REFERENCE	FREQUENCY	BY WHOM	COMMENTS
OTHER						
DESIGNATED SEISMIC SYSTEM COMPONENTS (AND ASSOCIATED ANCHORAGES) SUBJECT TO PROVISIONS OF ASCE 7 SECTION 13.2.1	CERTIFICATE OF COMPLIANCE	ASCE 7 SECTION 13.2.1	1705.13.2	EACH SYSTEM OR COMPONENT	MANUFACTURER	NOTE 2
DESIGNATED SEISMIC SYSTEM COMPONENTS (AND ASSOCIATED ANCHORAGES) SUBJECT TO PROVISIONS OF ASCE 7 SECTION 13.2.2	CERTIFICATE OF COMPLIANCE	ASCE 7 SECTION 13.2.2	1705.13.3	EACH SYSTEM OR COMPONENT	MANUFACTURER	NOTE 2
SEISMICALLY ISOLATED STRUCTURES	NONDESTRUCTIVE TESTING	ASCE 7 SECTION 17.8	1705.13.4	CONTINUOUS	MANUFACTURER	

NOTES:

1. TESTING AND QUALIFICATION FOR SEISMIC RESISTANCE ARE REQUIRED FOR SEISMIC-FORCE-RESISTING SYSTEMS IN STRUCTURES ASSIGNED TO SEISMIC DESIGN CATEGORY B, C, D, E, OR F,UNLESS OTHERWISE NOTED.

2. BASED ON ACTUAL TEST ON SHAKE TABLE, BY AN ANALYTICAL METHOD USING DYNAMIC CHARACTARISTICS AND FORCES, BY THE USE OF EXPERIENCE DATA, OR BY MORE RIGOROUS ANALYSIS PROVIDING FOR EQUIVALENT SAFETY.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
5. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Information Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Construction Submittals:
   a. Contractor's field office, storage yard, and storage building plans, including gravel surface area.
   b. Fencing and protective barrier locations and details.
   c. Plan for maintenance of existing plant operations.

1.03 MOBILIZATION

A. Mobilization includes, but is not limited to, these principal items:

1. Obtaining required permits.
2. Moving equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.

5. Arranging for and erection of Contractor's work and storage yard.
6. Posting OSHA required notices and establishing safety programs and procedures.
7. Having Contractor's superintendent at Site full time.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with Owner's safety rules while on Owner's property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

A. Power:

1. Electric power will be available at Site. Determine type and amount available and make arrangements for obtaining temporary electric power service for electric power used during Contract period, except for portions of the Work designated in writing by Engineer as substantially complete.
2. Cost of temporary electric power will be borne by the Contractor.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work. Where power shutdowns or electrical work prevent use of existing permanent lighting, provide temporary lighting in areas accessed regularly by plant operations staff.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.

4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. Owner will provide a place of temporary connection for construction and drinking water at Site. Provide temporary facilities and piping required to bring water to point of use and remove when no longer needed.
2. Owner will furnish drinking water required at no cost to Contractor on Site. Furnish and install temporary piping and facilities to transport water to the Work.
3. Contactor may use plant recycle (W3) required for testing equipment, tanks or basins, and piping prior to Substantial Completion
4. Provide and bear costs of necessary potable water required for testing tanks or basins prior to Substantial Completion, unless otherwise specifically stated in Specifications for equipment, systems, or facilities to be tested.
5. Provide temporary facilities and piping necessary to convey and meter potable water used during testing of tanks. Pay for potable water used for testing at Owner's standard rate.
6. Provide means to prevent water used for testing from flowing back into source pipeline.

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
2. Use of Owner's existing sanitary facilities by construction personnel will not be allowed.

F. Telephone Service:

1. Contractor: Arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.
2. No incoming calls allowed to Owner's plant telephone system.

G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
3. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
4. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
5. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
6. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
7. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
8. Maintain original Site drainage wherever possible.

B. Barricades and Lights:

1. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
2. Provide to protect existing facilities and adjacent properties from potential damage.
3. Locate to enable access by facility operators and property owners.
4. Protect plant roads that are closed to traffic by effective barricades with acceptable warning signs.

5. Locate barricades at the nearest intersecting public thoroughfare on each side of blocked section.
6. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

C. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on Drawings to remain undisturbed.
    a. Where practical, tunnel beneath trees when on or near line of trench.
    b. Employ hand excavation as necessary to prevent tree injury.
    c. Do not stockpile materials or permit traffic within drip lines of trees.
    d. Provide and maintain temporary barricades around trees.
    e. Water vegetation as necessary to maintain health.
    f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
    g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
    h. Dispose of removed trees in a legal manner off the Site.
2. Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Nursery and Landscape Association. Balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
4. Replace each plant that dies as a result of construction activities.

D. Existing Structures:

1. Where Contractor contemplates removal of small structures such as signposts and culverts that interfere with Contractor's operations, obtain approval of Engineer.
2. Replace items removed in their original location and a condition equal to or better than original.

E. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

F. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

G. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

3.03 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning: Of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.

2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
3. Comply with Section 01 57 13, Temporary Erosion and Sedimentation Control, for stormwater flow and surface runoff.
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as specified in Section 01 57 13, Temporary Erosion and Sedimentation Control, to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.04 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.05 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on Project. No employee or equipment parking will be permitted on Owner's existing paved areas.

C. Use area designated on Drawings for parking of Contractor's and Contractor's employees' vehicles.

3.06 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Maintenance of traffic is not required if Contractor obtains written permission from Owner. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.

D. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

3.07 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris. At least daily, sweep areas where demolition of structures or removal of debris is occurring.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This section covers Work necessary for stabilization of soil to prevent erosion and sedimentation during construction and land disturbing activities. The Work shall include the furnishing of all labor, materials, tools, and equipment to perform the Work and services necessary as herein specified and as indicated on the Drawings. This shall include installation, maintenance, and final removal of all temporary soil erosion and sediment control measures and installation of permanent soil erosion control practices.

B. The minimum areas requiring soil erosion and sediment control measures are indicated on the Drawings. The right is reserved to modify the use, location, and quantities of soil erosion and sediment control measures based on activities of Contractor and as the Engineer considers to be to the best interest of the Owner.

C. See additional information shown on the Drawings.

D. Erosion and sediment control practices shall comply with the "Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas," latest edition.

1.02 DEFINITIONS

A. BMP: Best management practice, means schedule of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, and waste disposal.

B. Certified Contractor: A person who has received training and is a certified professional to install/construct, inspect and maintain erosion and sediment control practices.

C. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

D. Construction Exit: A stone stabilized pad located at any point where traffic will be leaving a construction site to a public right-of-way, street, alley, sidewalk, or parking area or any other area where there is a transition from bare soil to a paved area.

E. ESC: Erosion and sediment control. Any temporary or permanent measures that prevent or reduce erosion, control sedimentation, and ensure that sediment does not leave a site.

F. Land Disturbing Activity: Any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, excavation and filling.

G. Maintenance Period: Maintenance period begins immediately after each area is planted and shall continue for a period of 8 weeks after all seeding, sodding, and planting are completed.

H. Project Limits: Areas, as shown or specified, within which Work is to be performed.

I. Sediments: Soil, sand, and minerals washed from land into water, usually after a rain event.

J. Standard Specifications: When referenced in this section, shall mean the current edition of the Alabama Department of Transportation Standard Specifications for Highway Construction.

1.03 GENERAL

A. All activities shall conform to the Alabama Handbook and the City of Montgomery requirements. In the event of a conflict, the more stringent requirement shall apply.

B. Perimeter sediment control practices shall be installed prior to commencement of land disturbance activities.

C. Prior to commencing land disturbance activities, the Contractor shall clearly and accurately demarcate the limits of land disturbance with clearing limit fence, for the entire duration of the Project. This may exclude areas of trenching that cut across the site.

D. No land disturbance shall occur outside the limits indicated in the Drawings, unless approved by the Engineer.

E. The location of some erosion and sediment control measures may have to be altered from those shown on the Drawings if drainage patterns during construction differ from the ones shown on the Drawings. Contractor is responsible to accomplish erosion and sediment control for all drainage patterns created during various stages of construction. Contractor shall report to the Engineer any difficulty in controlling erosion during any phase of construction.

F. Soil erosion stabilization and sedimentation control consist of, but not limited to, the following elements:

1. Conducting earthwork and excavation activities in such a manner to fit the topography soil type and condition.
2. Implementation and continuous maintenance of BMP's.
3. Minimize disturbed area and duration of exposure to erosion elements.
4. Stabilize disturbed areas immediately:
    a. Topsoil and seeding:
        1) Placement and maintenance of Temporary Seeding on all areas disturbed by construction.
        2) Placement of permanent topsoil, fertilizer, and seed, etc., in all areas not occupied by structures or pavement, unless shown otherwise.
    b. Soil Stabilization Seeding: Placement of fertilizer and seed, etc., in areas as specified hereinafter.
5. Construction or installation of temporary erosion control facilities such as, silt fences, check dams, diversion dikes, construction exit, etc.
6. Construction or installation of permanent erosion control facilities such as check dams, riprap, permanent vegetation, etc.

G. The areas set aside for the Contractor's use during the Project may be temporarily developed to provide satisfactory working, staging, and administrative areas for his exclusive use. Preparation of these areas shall be in accordance with other requirements contained within these Specifications and shall be done in a manner to both control all sediment transport away from the area.

H. Contractor is responsible for maintaining all erosion control measures installed for the full duration of this Contract.

I. Mulch or temporary seeding shall be applied to all disturbed areas within 5 days of clearing. All disturbed areas that are stabilized with mulch shall be stabilized with temporary seeding after 14 days.

J. Areas opened by construction operations and that are not anticipated to be re-excavated or dressed and received final grassing treatment within 30 days shall be temporary seeded with a quick growing grass species which will provide an early cover during the season in which it is planted and will not compete with the permanent grassing.

K. Upon completion of construction, and after the site is stabilized, the Contractor shall remove all temporary erosion control measures and dispose of them, unless noted on the Drawings. Permanent seeding shall be applied to all remaining disturbed areas.

L. Contractor's failure to install, operate and maintain all erosion and sediment control measures, to the satisfaction of the Engineer and the Owner, will result in all construction being stopped on the job until such measures are installed or returned to their proper functional condition.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00, Submittal Procedures:

1. Shop Drawings.
2. Product Data.

B. In addition, the Contractor shall provide the following specific information:

1. Site Plans identifying any field changes and location of Construction Exit.
2. Supporting calculations from any deviation from the approved ESC plans.
3. Sequence and schedule of activities; such as ESC installation, ESC maintenance, site clearing, grading, construction activities, construction of utilities, infrastructure and buildings, final grading, and temporary and final stabilization and removal of all ESC measures. Schedule shall identify the expected date and duration of each activity.

PART 2 PRODUCTS

2.01 SEDIMENT FENCE

A. Type-B sediment fence in accordance with the "Alabama Handbook".

2.02 CLEARING LIMIT/ORANGE BARRIER FENCE

A. Fabric:

1. Ultraviolet stabilized polyethylene, polypropylene, or nylon filaments woven into uniform pattern, with distinct and measurable openings.
2. Color: Yellow or orange.
3. Height: Minimum 48 inches.
4. Material Edges: Finished in order that filaments retain their relative positions under stress.

B. Posts: Conventional metal "T" or "U" posts.

2.03 TOPSOIL

A. As specified under Section 32 92 00, Turf and Grasses.

2.04 FERTILIZER

A. As specified in Section 32 92 00, Turf and Grasses.

2.05 MULCH

A. Wood Cellulose Fiber Mulch:

1. Specially processed wood fiber containing no growth or germination inhibiting factors.
2. Dyed suitable color to facilitate inspection of material placement.
3. Manufactured such that after addition and agitation in slurry tanks with water, material fibers become uniformly suspended to form homogenous slurry.
4. When hydraulically sprayed on ground, material will allow absorption and percolation of moisture.

B. Straw:

1. Clean salt hay or threshed straw of oats, wheat, barley, or rye, free from seed of noxious weeds. Suitable for spreading with mulch blower equipment.
2. Average Stalk Length: 6 inches.
3. Seasoned before baling or loading.

2.06 WATER FOR DUST CONTROL

A. Free of hazardous or toxic contaminates.

2.07 CONSTRUCTION EXIT

A. ALDOT No. 1 stone.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall install erosion and sediment control measures and maintain in accordance with the Drawings.

B. The Contractor shall provide and maintain soil stabilization at all times.

C. After installation of the initial erosion and sediment control measures, the Contractor shall schedule an inspection with the Engineer and the Local Agency's site inspector. No other construction activities shall occur until the Engineer approves the installation of the initial erosion and sediment control measures. If unforeseen conditions exist in the field that warrants the installation of additional erosion and sediment control measures, the Contractor must install any additional measures deemed necessary by the Engineer.

D. Contractor shall observe the approved Project sequence. The Contractor shall maintain careful scheduling and performance to ensure that the exposure of land area stripped of its natural cover is kept to a minimum.

E. Contractor shall be responsible for phasing Work in areas allocated for their exclusive use during Project, including proposed stockpile areas and installation of temporary erosion control devices, ditches, or other facilities

3.02 SILT FENCE

A. The Contractor shall construct silt fence Type-B in accordance with the "Alabama Handbook" where shown and at locations determined by the Engineer or the Local Agency.

3.03 SEEDING

A. As specified in Section 32 92 00, Turf and Grasses.

3.04 MULCHING

A. Apply uniformly on seeded areas.

B. Application: Sufficiently loose to permit penetration of sunlight and air circulation, and sufficiently dense to shade ground, reduce evaporation rate, and prevent or materially reduce erosion of underlying soil.

1. Straw: Apply by hand or mechanical means to minimum depth of 2 inches.
2. Wood Cellulose Fiber: 1,000 to 1,500 pounds per acre.

3.05 CLEARING LIMIT /ORANGE BARRIER FENCE

A. Before beginning clearing and grubbing operations, install at limits of clearing.

B. Drive posts a minimum of 18 inches into ground at maximum spacing of 6 feet.

C. Remove after permanent stabilization is complete and accepted by Engineer.

3.06 SOIL STOCKPILES

A. Protect from erosion with silt fence.

B. Seed stockpile, not active for 14 days, with soil stabilization seed, surrounded by silt fence and a permanent 2-foot minimum depth perimeter ditch located within 10 feet of the toe of stockpile slope.

C. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond immediate stockpile area by construction of temporary toe-of-slope ditches and accompanying silt fences, as necessary. Keep these temporary facilities in operational condition by regular cleaning, regrading, and maintenance.

3.07 DUST CONTROL

A. Contractor shall control, at all times, surface and air movement of dust.

B. Sprinkler site with water until the surface is wet. Repeat as needed.

3.08 CONSTRUCTION EXIT

A. Construct a Construction Exit to allow for removal of mud from the tires.

B. Provide a stone stabilized pad at location defined by the Contractor in the Erosion Control Submittal, as follows:

1. Width: 20 feet minimum.
2. Length: 50 feet minimum.
3. Thickness: 6 inches minimum.

C. Provide non-woven geotextile between soil and stone.

D. If the action of the vehicle traveling over the stone pad does not sufficiently remove the mud, the tires should be washed prior to entrance onto public rights-of-way.

E. When washing is required, it shall be done on an area stabilized with crushed stone and provisions that intercept the sediment-laden runoff and direct it into an approved sediment trap or sediment basin.

3.09 FIELD QUALITY

A. Conduct inspections jointly with Engineer and/or the Local Agency's Inspector every 2 weeks to evaluate conformance to requirements of Specifications and the Drawings.

B. Replace or repair failed or overloaded silt fences, check dams, or other temporary erosion control devices within 2 days after receiving written notice from Engineer and/or Local Agency.

3.10 MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES

A. Erosion and sediment control measures shall be maintained at all times until permanent stabilization of the site is achieved.

B. Erosion and sediment control measures shall be checked after each rain event, and shall be immediately repaired or replaced if found to be defective. A record shall be maintained of all inspections, repairs and replacement.

C. Contractor shall inspect erosion and sediment control measures each week and after every rain event to ensure that they are working properly.

D. Construction exit shall be top dressed with additional material periodically to maintain minimum depth of 6 inches. All materials spilled, dropped, washed, or tracked from vehicles or site onto roadways or into storm drains must be removed immediately.

E. Sediment fence shall be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground. Build up sediment shall be removed from silt fence when it has reached one-half the height of the fence.

F. Each BMP is to be maintained or replaced if the accumulated sediment depth is equal to or greater than one-half of the capacity of the device. Reference marks denoting the elevation at which each device is to be maintained shall be placed on all devices.

G. Mulch or temporary seeding shall be applied to all disturbed areas within 5 days of clearing. All disturbed areas stabilized with mulch shall be stabilized with temporary seeding after 14 days.

H. Temporary and permanent seeding, sodding, and planting shall be inspected for bare spots, washouts, and healthy growth. All the permanent seeded grass cover areas shall be reworked and reseeded if 75 percent grass cover is not achieved within 14 days.

I. If full implementation of the approved Plans does not provide for effective erosion and sediment control, additional ESC measures shall be implemented as directed by the Engineer or the Local Agency.

J. A maintenance inspection report shall be made after each inspection by the Contractor. The reports will be kept onsite during construction and available upon request by the Owner, the Engineer, the County, or any Federal or Local Agency approving erosion and sediment control plans. The report shall identify any incidents of non-compliance.

K. Contractor shall install and add to erosion control measures as determined by the Engineer, Owner or Local Authority.

L. The Contractor shall maintain all elements of the ESC measures and facilities to be constructed during this Project for the duration of his activities on this Project. Formal inspections made jointly by the Contractor and the Engineer shall be conducted every 2 weeks to evaluate the Contractor's conformance to the Approved Drawings and this Specification.

M. All silt traps shall be cleaned of collected sediment after every storm or as determined from the biweekly inspections. Cleaning shall be done in a manner that will not direct the sediment into the storm drain piping system. Removed sediment shall be taken to an area selected by the Engineer where it can be cleaned of sticks and debris, then allowed to dry. Final sediment and debris disposal shall be onsite as designated by Engineer or Owner.

N. Replacement or repair of failed or overloaded silt fences and other temporary erosion control devices shall be accomplished by the Contractor within 2 days after receiving written notice from the Engineer.

O. Unpaved earth drainage ditches shall be regraded as needed to maintain original grade and remove sediment buildup. If a ditch becomes difficult to maintain, the Contractor shall cooperate with the Engineer and install additional erosion control devices such as check dams, temporary paving, or silt fences as directed by the Engineer.

P. If the Contractor has not complied with any of the above maintenance efforts to the satisfaction of the Engineer within 2 working days after receiving written notification from the Engineer, the Owner shall have the prerogative of engaging others to perform any needed maintenance or cleanup, including removal of accumulated sediment at constructed erosion control facilities, at Contractor’s expense.

3.11 CLEANING

A. Dress sediment deposits remaining after fence has been removed to conform to existing grade. Prepare and grass graded area per specification 32 92 00, Turf and Grasses.

END OF SECTION

SECTION 01 57 28
TEMPORARY FLOW CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Inspection, Cleaning, and Restoration Certification (IICRC): S500, Standard and Reference Guide for Professional Water Damage Restoration.

1.02 DEFINITIONS

A. Bypass Pumping: Temporary flow control accomplished by diverting flow away from the Work area using one or more pumps.

B. Temporary Flow Control: Reducing, limiting, or excluding flow in or to a sanitary sewer, storm sewer, pump station, force main, or other facility as required for performing the Work under the Contract. Draining, handling, and disposal of sanitary sewage and stormwater from pipelines and other facilities as required for performing the Work under the Contract is also part of temporary flow control.

C. Temporary Flow Control Plan: Plan prepared by Contractor containing complete information on how Contractor proposes to perform temporary flow control in accordance with specified requirements.

1.03 SYSTEM DESCRIPTION

A. Provide facilities and controls required to intercept, convey, and discharge flow to be controlled; include standby and emergency equipment.

B. Conform to regulatory requirements.

C. Protect water resources, wetlands, and other natural resources.

D. Temporary flow control shall be done in a manner that will not damage private or public property, or create a nuisance or public menace. Flow shall be conveyed in enclosed pipes that are adequately protected from traffic or other hazards.

E. Temporary flow control facilities shall be established and tested prior to the removal of existing pump station pumping equipment from service.

F. Discharge:

1. To existing facilities as described in this Specification.
2. Dumping or free flow on private or public property, gutters, streets, or sidewalks is prohibited.
3. Discharge of sanitary sewage to storm sewers, to surface waters or wetlands, or into the ground, is prohibited.

1.04 SITE CONDITIONS

A. Existing facilities and improvements in vicinity of the new headworks are shown on the Drawings.

1. Existing Headworks
   a. Influent: Existing Headworks receives raw sewage flow via a 14-inch ductile iron force main that is pumped from Pump Station 53 (Milley's Creek Regional PS) and from Pump Station 56 (Stone Park).
   b. Continuous operation of the existing treatment facility is of critical importance. Contractor shall ensure that existing Headworks will operate continuously, until connection and startup of new screening system.
   c. All piping tie-ins shall be completed within 2-hours. Outage time includes time to drain the pipe therefore any arrangements needed to drain piping shall be provided by Contractor and included in the Contractor's lump sum bid. Any outages that are expected to last longer than 2 hours in duration will require the Contractor to provide and install a means of temporary pumping that bypasses the existing Headworks and pumps influent flow directly to the splitter box.
   d. If bypassing the existing Headworks is required, Contractor shall provide pumping capacity of at least 2.5 MGD exclusive of spare pumps.
      1) Schedule and sequence bypass operations to coordinate with the other work to minimize the duration of bypass operations
      2) Bypass operations must be continuously monitored exclusive of off-site electronic monitoring

1.05 SUBMITTALS

A. Informational Submittals:

1. Temporary Flow Control Plan.
2. Emergency Cleanup Plan.
3. Information describing equipment and materials to be used and showing conformance with specified requirements.
4. Provisions to be made to provide power for any temporary pumping systems that are proposed to be provided which will operate on electricity vs. the use of engine driven pumps. The Contractor may need to provide a temporary power feed from Alabama Power Company depending on the power requirements associated with the temporary pumps that are proposed. All materials, equipment, and fees associated with providing a temporary power system from Alabama Power shall be provided by the Contractor. Additionally, all electricity that is used during the bypass event shall also be paid for by the Contractor.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Temporary Flow Control System Designer: Professional engineer who has at least 5 years' experience in design of such systems and who is registered in the State of Alabama.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Install temporary flow control facilities within the Boundaries of the Milley's Creek WPCP. Consider construction work in the area when determining best location for temporary pump setup.

B. Operate and maintain temporary flow control 24 hours per day, 7 days per week, including without limitation, holidays, as required to control flows.

C. Promptly remove temporary flow control facilities as soon as they are no longer needed.

3.02 BYPASS PUMPING SUPERVISION

A. Contractor shall maintain suitable personnel on Site 24 hours per day, 7 days per week for duration of bypass pumping. Personnel shall be capable of detecting issues with and performing simple troubleshooting for the bypass pumping system.

B. Contractor shall maintain on-call personnel 24 hours per day 7 days per week during duration of bypass pumping. On-call personnel shall be capable of trouble shooting bypass system components and equipment.

3.03 AUTOMATIC NOTIFICATION OF FAILURE

A. Bypass systems shall have automated notification of failure that notifies both the Contractor and Owner via autodialer. Failure shall be determined by failure of pumps(s) to run when called to do so.

3.04 EQUIPMENT AND MATERIALS

A. General:

1. Provide materials and equipment that will ensure continuous and successful operation of temporary flow control systems.
2. Repair or modify systems as necessary.
3. Unless otherwise shown or specified, materials and equipment may be new or used at Contractor's option.

B. Plugs:

1. Provide with taps for connection of pressure gauges and air hoses, and flow-through capability.
2. Pipe Diameters 24 Inches and Smaller: Use mechanical plugs with rubber gaskets or pneumatic plugs with rubber boots.
3. Pipe Diameters Larger than 24 Inches:
    a. Use inflatable bag stoppers made in two or more pieces.
    b. Manufacturers:
        1) Lansas.
        2) Cherne Industries.

C. Pumps:

1. Both Duty and Stand-by bypass pumps shall be capable of handling the Firm Capacity at the station at which they will be used.
2. Fully automatic, self-priming units that do not require use of foot valves or vacuum pumps in priming system.
3. Solids handling design with ability to pump minimum 3-inch diameter sphere.

4. Able to run dry for long periods of time to accommodate cyclical nature of flows.
5. Engine: Equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from source.

D. Piping and Valves:

1. High-Density Polyethylene (HDPE) or Ductile Iron Discharge Piping:
   a. Leak Free.
   b. Pressure rating at least 1.5 times operating pressure.
   c. HDPE Pressure Piping:
      1) In accordance with ASTM D3350.
      2) SDR of 32.5, maximum.
      3) Joints: Butt-fusion welded.
   d. Ductile Iron:
      1) AWWA C151/A21.51, Centrifugally cast, Grade 60-42-10 iron.
      2) Joints: Mechanically Restrained.
2. Owner or Engineer, at their sole discretion, shall have right to reject sections deemed unserviceable.
3. Install piping and valves in such a way that pumps may be disconnected from bypass piping system without impact operating of bypass pumping.
4. Duty and Standby pumps must be connected to bypass piping system such that standby pumps may be operated with without requiring relocation or reconnection of piping.

E. Electric Power Generators:

1. Be able to simultaneously start and run electric powered pumps required for flow to be controlled.
2. Equipped to minimize noise. Noise levels shall not exceed 86 dBA at a distance of 50 feet from source.

F. Standby Equipment:

1. Standby Pump: One of each size to be available onsite.
2. Electric Power Generators: Minimum of one if temporary flow control system contains electric powered pump. Able to simultaneously start and run electric powered pumps required for flow to be controlled.

3.05 TEMPORARY POWER

A. The use of electric vs. engine drive pumps may require the Contractor to provide temporary power feed to the bypass pumping equipment. Any temporary power feed that may be required shall be provided by the Contractor at his own expense. Additionally, the Contractor shall also be responsible for coordinating any and all requirements associated with the temporary power system with Alabama Power.

3.06 TEMPORARY FLOW CONTROL PLAN

A. Prepare and submit Temporary Flow Control Plan at least 30 days before starting the Work requiring temporary flow control; include following information:

1. Drawings indicating location of temporary sewer plugs and bypass discharge lines.
2. Locations where flow will be intercepted and discharged.
3. If trucks are to be employed include the following:
    a. Numbers and sizes of trucks.
    b. Configuration of facilities to be used to load trucks at each interception location.
    c. Locations where trucks will unload.
    d. Time for loading, unloading, and travel.
4. Complete descriptions and performance characteristics of pumps, electric power generators, and other temporary equipment that may be required.
5. Acoustical information for equipment to be used showing compliance with noise control requirements of Section 01 50 00, Temporary Facilities and Control.
6. Details of temporary force mains, including horizontal and vertical alignments, pipe materials, protection of existing buried and aboveground facilities and improvements, maintenance of traffic and access to properties.
7. Design calculations proving adequacy of temporary system and selected equipment to convey all flows.
8. Drawings showing layouts and configurations of temporary flow control facilities and also showing locations relative to right-of-way easement, and property boundaries.
9. Drawings and design calculations of temporary bulkheads and plugs.
10. Drawings and design calculations for thrust restraint of temporary piping.

11. Details of system controls and control logic; include diagrams and narrative.
12. Anticipated schedule for the Work.
13. Other information to completely describe temporary flow control facilities and conformance to specified requirements.

3.07 EMERGENCY CLEANUP PLAN

A. Prepare and submit not less than 60 days before scheduled date of temporary flow control activities. As a minimum plan shall include the following:

1. Procedures for removal of water.
2. Procedures for determining nature and extent of damage and required restoration where restoration is possible.
3. Provide for industrial hygienist and standby Subcontractor for cleanup of exterior and building interior spaces that might be affected by a spill, backup, or overflow. Industrial hygienist and cleanup Subcontractor shall be certified by IICRC and follow IICRC S500 for cleanup of Category 3 water.

B. Implement for Full Scale Test and during temporary flow control.

3.08 BLOCKING FLOW

A. Flow control may consist of blocking flow with mechanical or pneumatic plugs if only small amount of flow needs to be controlled and adequate storage is available.

B. Use primary and secondary plugs for each flow control location.

C. When blocking flow is no longer needed for performance and acceptance of the Work, remove plugs in a manner that permits sewage flow to slowly return to normal without surcharging or causing other major disturbances downstream.

D. Remove temporary plugs at end of each working day and restore normal flow. If downstream work is not or cannot be completed during workday provide, operate, and maintain bypass pumping system or other method of flow control to accommodate flows.

3.09 PIPING

A. Minimize disturbance of existing utilities.

B. Where temporary flow control pipelines cross streets and private driveways, install pipeline in trench and cover with temporary pavement.

C. Installation of bypass pipelines is prohibited in salt marsh/wetland areas.

3.10 FIELD QUALITY CONTROL

A. Hydrostatic Pressure Test for Pump Bypass Systems:

1. Prior to operation, test each section of discharge piping with maximum pressure equal to 1.5 times maximum operating pressure of system. Contractor shall hold required pressure for minimum of 1 hour.
2. Notify Engineer 24 hours prior to testing.

B. Full Scale Test:

1. At least 14 days prior to test, notify Engineer of date and time of test.
2. Do not begin temporary flow control activities until successful test has been completed.
3. Conduct on proposed temporary flow control at least 14 days before scheduled date of actual proposed temporary flow control.
4. Purpose of test is to demonstrate capability, function, and reliability of Contractor's proposed method of temporary flow control.
5. Duration: Minimum of five (5) days to include a Friday, Saturday, and Sunday.
6. If electric pumps are being used, provide standby generators to ensure continuity of pumping operation in event of power failure.
7. Demonstrate system controls and operation, reliability, and transfer to standby equipment during test.
8. Conduct until flow is accommodated for minimum specified test duration.
9. Failure:
    a. Test shall be deemed to have failed if during test flows are not accommodated for whatever reason and for whatever length of time.
    b. If test fails, determine and correct deficiencies that caused test to fail and conduct another Full Scale Test.
10. Determination by Engineer of a successful test, permission by Engineer to proceed with the Work requiring temporary flow control, or anything else shall not relieve Contractor from responsibility to provide temporary flow control.

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of 2018 International Building Code (IBC) by International Code Council as amended by City of Montgomery; 2022 City of Montgomery Code of Ordinances; and all other requirements by state and applicable local agencies.

1. Refer to the General Structural Notes on Drawings for Project-specific design criteria.
2. Refer to individual Specification sections and to Drawings for additional design criteria.

B. Where Contractor design is specified, installation, systems, equipment, and components, including supports and anchorage, shall be designed by a qualified professional engineer registered in state where Project will be constructed.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Where Contractor design is specified, the following submittals shall be sealed, signed and dated by a registered professional engineer licensed in state where Project will be constructed and competent in the area of practice for the specified design:
   a. Shop, fabrication, erection and installation drawings.
   b. Calculations.

1.04 SUBMITTALS

A. Where Contractor design is specified, submit shop, fabrication, erection and installation drawings as Action Submittals, unless otherwise specified.

B. Where Contractor design is specified, submit calculations as Informational Submittals, unless otherwise specified.

C. Sealed submittals shall be in accordance with the laws, rules and regulations of state where Project will be constructed.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 200 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 0 degrees F to 120 degrees F.

1.06 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
   a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
   b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
   b. Prominently displayed on each package, the following:
      1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.
4. Deliver materials to Site.

_____
Name

_____, _____, _____, _____
Street City State Zip

5. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.07 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer’s instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.08 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer’s written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer’s recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer’s instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer's standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with finish as approved by Owner.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer’s instructions, and as may be specified. Retain a copy of manufacturers’ instruction at Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As required in General Conditions.
   b. Special bonds, Special Guarantees, and Service Agreements.
   c. Consent of Surety to Final Payment: As required in General Conditions.
   d. Releases or Waivers of Liens and Claims: As required in General Conditions.
   e. Releases from Agreements.
   f. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
   g. Extra Materials: As required by individual Specification sections.
   h. Final Operation and Maintenance Manuals. See Section 01 78 23, Operation and Maintenance Data.
2. No Contract will be finalized until all guarantees, bonds, certifications, licenses, and affidavits required for Work or equipment as specified are satisfactorily filed with the Engineer.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.

3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Engineer at no cost to Contractor, one complete set of Contract Documents.

2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
    a. Color Coding:
        1) Green when showing information deleted from Drawings.
        2) Red when showing information added to Drawings.
        3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
    a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
    b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
    c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
    d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
    e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
    a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.
    b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
    c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

3.03 FINAL INSPECTION

A. After final cleaning and upon written notice from Contractor that Work is completed, Engineer will make preliminary inspection with the Owner and Contract present. Upon completion of preliminary inspection, Engineer will notify Contractor in writing of particulars in which the completed Work is defective or incomplete.

B. Upon receiving written notice from Engineer, Contractor shall immediately undertake Work required to remedy defects and complete the Work to the satisfaction of the Engineer and Owner.

C. After the items as listed in Engineer's written notice are corrected or completed, inform Engineer in writing that required Work has been completed. Upon receipt of this notice the Engineer, in the presence of the Owner and Contractor, will make final inspection of the Project.

D. Should the Engineer find all Work satisfactory at the time of the final inspection, Contractor will be allowed to make application for final payment in accordance with provisions of the General Conditions. Should the Engineer still find deficiencies in the Work, the Engineer will notify Contractor in writing of deficiencies and will not approve Contractor's request for final payment until such time as the Contractor has satisfactorily completed the require work.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Engineer's review.

B. Final Data: Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.
2. Final Data: Compilation Manual Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.
   a. Submit separate compilation manuals for each pump station.

1.04 DATA FORMAT

A. Prepare preliminary data in the form of an instructional manual. Prepare final data in data compilation format.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
2. Size: 8-1/2 inches by 11 inches, minimum.

3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
    a. Project title.
    b. Designate applicable system, equipment, material, or finish.
    c. Identity of separate structure as applicable.
    d. Identify volume number if more than one volume.
    e. Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
4. Spine:
    a. Project title.
    b. Identify volume number if more than one volume.
5. Title Page:
    a. Contractor name, address, and telephone number.
    b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
        1) Identify area of responsibility of each.
        2) Provide name and telephone number of local source of supply for parts and replacement.
6. Table of Contents:
    a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
    b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
7. Paper: 20-pound minimum, white for typed pages.
8. Text: Manufacturer's printed data, or neatly typewritten.
9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Submit separately for each pump station.
2. Compile all Engineer-accepted preliminary O&M data into one electronic PDF copy and three hard-copy, hard-bound sets.
3. Each set shall consist of the following:
    a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
    b. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___", and list:
        1) Project title.
        2) Contractor's name, address, and telephone number.

3) If entire volume covers equipment or system provided by one Supplier include the following:
   a) Identity of general subject matter covered in manual.
   b) Identity of equipment number and Specification section.

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:
   1) Include list of each product, indexed to content of each volume.
   2) Designate system or equipment for which it is intended.
   3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:
   1) Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.
   2) Fly-Leaf:
      a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
      b) List with Each Product:
         (1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
         (2) Identify area of responsibility of each.
         (3) Provide local source of supply for parts and replacement.
      c) Identity of separate structure as applicable.

f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. USB External Storage Device:

1. Provide three USB external storage devices prior to close-out of the project.
2. Storage devices shall each contain the following:
   a. PDF compilation O&M Manual.
   b. All project submittals.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit two copies for Engineer's review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be forwarded to Resident Project Representative.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
      2) Engineer's comments will be retained in Engineer's file.
      3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit electronic copy and three hard copies.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
    a. Format:
        1) Provide reinforced, punched, binder tab; bind in with text.
        2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
        3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
        4) Identify Specification section and product on Drawings and envelopes.
    b. Relations of component parts of equipment and systems.
    c. Control and flow diagrams.
    d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
    a. Format:
        1) Organize in consistent format under separate heading for each different procedure.
        2) Provide logical sequence of instructions for each procedure.
        3) Provide information sheet for Owner's personnel, including:
            a) Proper procedures in event of failure.
            b) Instances that might affect validity of guarantee or Bond.
    b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
    c. Operating Procedures:
        1) Startup, break-in, routine, and normal operating instructions.
        2) Test procedures and results of factory tests where required.
        3) Regulation, control, stopping, and emergency instructions.
        4) Description of operation sequence by control manufacturer.
        5) Shutdown instructions for both short and extended duration.
        6) Summer and winter operating instructions, as applicable.
        7) Safety precautions.
        8) Special operating instructions.
    d. Maintenance and Overhaul Procedures:
        1) Routine maintenance.
        2) Guide to troubleshooting.
        3) Disassembly, removal, repair, reinstallation, and re-assembly.
6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
    a. Function, normal operating characteristics, and limiting conditions.
    b. Performance curves, engineering data, nameplate data, and tests.
    c. Complete nomenclature and commercial number of replaceable parts.
    d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards:
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
    a. Routine and normal operating instructions.
    b. Startup and shutdown sequences, normal and emergency.
    c. Safety precautions.
    d. Special operating instructions.
10. Maintenance Procedures:
    a. Routine maintenance.
    b. Guide to troubleshooting.
    c. Adjustment and checking.
    d. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
    a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
    b. Each Maintenance Summary may take as many pages as required.
    c. Use only 8-1/2-inch by 11-inch size paper.
    d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
    a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
    b. "Unit" is the unit of measure for ordering the part.
    c. "Quantity" is the number of units recommended.
    d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
    a. Catalog number, size, and composition.
    b. Color and texture designations.
    c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
    a. Manufacturer's recommendation for types of cleaning agents and methods.
    b. Cautions against cleaning agents and methods that are detrimental to product.
    c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
    a. Applicable standards.
    b. Chemical composition.
    c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENTS

A. The supplement listed below, following "End of Section", is part of this Specification.

1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT:_____ CONTRACT NO.:_____

1. EQUIPMENT ITEM_____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

   a. Name_____ Telephone No. _____

   b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 88 15
ANCHORAGE AND BRACING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2021 International Building Code (IBC), for seismic, wind, gravity, soil, and operational loads.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
2. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
3. International Code Council (ICC): International Building Code (IBC).

1.03 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

B. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

C. Component Important Factor:

1. Ip > 1.0, unless noted otherwise.
2. Ip shall be taken as 1.5 if any of the following conditions apply:
   a. Component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.

b. Component contains hazardous materials.
c. Component is in or attached to Risk Category IV structure and is needed for continued operation of facility or its failure could impair continued operation of facility.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Alabama.
2. Design anchorage into concrete including embedment in accordance with ACI 318-19; Chapter 17 (or other industry standard approved by Engineer), and Project Specifications.
   a. Unless otherwise noted, design for cracked concrete condition.
3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
6. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
7. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
8. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
9. Design anchorage and bracing for:
   a. Equipment and components that weigh more than 400 pounds.
   b. Equipment weighing more than 20 pounds.
   c. Mechanical and electrical components that are not provided with flexible connections between components and associated ductwork, piping, or conduit.
   d. Distribution systems that weigh more than 5 pounds per foot.
10. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
3. Operational:
    a. For loading supplied by equipment manufacturer for IBC required load cases.
    b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
    c. Locate braces to minimize vibration to or movement of structure.
    d. For vibrating loads, use anchors meeting requirements of Section 05 50 00, Metal Fabrications or Section 05 05 19, Post-Installed Anchors, for anchors with designated capacities for vibratory loading per manufacturer’s ICC-ES report.
4. Seismic:
    a. In accordance with 2021 IBC, Section 1613, and Chapter 13 of ASCE 7.
    b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.
    c. Design forces for anchors in concrete or masonry shall be in accordance with ASCE 7, Section 13.4.2, or IBC Section 1905.1.8 as applicable for Project Seismic Design Category.

C. Seismic Design Requirements:

1. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component Ip = 1.5.
2. The following are exempt from requirements for provision of seismic anchorages and bracing, in addition to those items specifically exempted in ASCE 7, Part 13.5 for architectural components and Part 13.6 for electrical and mechanical equipment:
    a. Furniture, except storage cabinets and bookshelves over 6 feet tall.
    b. Temporary or movable equipment.

3. Provide support drawings and calculations for electrical distribution components for seismic forces and relative displacements as required in ASCE 7-16 Section 13.3.
    a. Exceptions in accordance with ASCE 7-16 Section 13.6.5.
4. Existing components, systems, and equipment in their final condition that are modified by Project requirements and are not exempted by above paragraph require the same anchorage and bracing drawing and calculation submittals as new equipment. Field verify existing conditions.
5. Other seismic design and detailing information identified in ASCE 7, Chapter 13, is required to be provided for new and modified or noted architectural, mechanical and electrical components, systems, or equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
    b. Manufacturers' engineered seismic and non-seismic hardware product data.
    c. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
    d. List of existing architectural, mechanical, and electrical equipment or components to be modified in Project requiring Contractor-designed anchorage and bracing in final retrofitted condition.
    e. Drawings for seismic attachment assemblies include connection hardware, braces, and anchors (or anchor bolts) for modified, nonexempt existing components, equipment, and systems where a combination of new and existing systems or components' final condition would require anchorage or bracing under this specification for new equipment.
    f. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of Alabama.
2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections in Supplement located at the end of Section 01 45 33, Special Inspection, Observation, and Testing, and Section 01 45 33, Special Inspection, Observation, and Testing.

B. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

C. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.01 GENERAL

A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 horsepower.

PART 3 EXECUTION

3.01 GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.

D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

1. Piping and ductwork suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments, unless high-deformability piping is used per ASCE 7, Section 13.6.8 or HVAC ducts have a cross-sectional area of less than 6 square feet.
    a. Exceptions in accordance with ASCE 7-16 Sections 13.6.6 and 13.6.7.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

F. Do not attach architectural, mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

B. Notify Engineer upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 50 00, Metal Fabrications and Section 05 05 19, Post-Installed Anchors.

B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Facility: Headworks.

B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as pumps.

E. Facility Performance Demonstration:

1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

1.02 SUBMITTALS

A. Informational Submittals:

1. Functional and performance test results.
2. Completed Unit Process Startup Form for each unit process.
3. Completed Facility Performance Demonstration/Certification Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.

B. Contractor's Testing and Startup Representative:

1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

E. Owner will: Provide water, power, and other items as required for startup, unless otherwise indicated.

3.02 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
   a. Owner/Project Name.
   b. Equipment or item tested.
   c. Date and time of test.
   d. Type of test performed (Functional or Performance).
   e. Test method.

f. Test conditions.
g. Test results.
h. Signature spaces for Contractor and Engineer as witness.

5. Cleaning and Checking: Prior to beginning functional testing:
   a. Calibrate testing equipment in accordance with manufacturer's instructions.
   b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
   c. Lubricate equipment in accordance with manufacturer's instructions.
   d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
   e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
   f. Check power supply to electric-powered equipment for correct voltage.
   g. Adjust clearances and torque.
   h. Test piping for leaks.
6. Ready-to-test determination will be by Engineer based at least on the following:
   a. Acceptable Operation and Maintenance Data.
   b. Notification by Contractor of equipment readiness for testing.
   c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
   d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
   e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
   f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
   g. Equipment and electrical tagging complete.
   h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
4. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking performance measurements.
5. Prepare Equipment Test Report summarizing test method and results.
6. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of Engineer, startup of all facility components has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between pump station components.

C. After facility is operating, complete performance testing of equipment and systems not previously tested.

D. Document, as defined in Facility Startup and Performance Demonstration Plan, the performance of the facility.

E. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic operation.

3.04 SUPPLEMENTS

A. Supplement listed below, following "End of Section," is a part of this Specification:

1. Facility Performance Demonstration/Certification Form.

END OF SECTION

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER:_____ **PROJECT:**_____

Unit Processes Description (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____

_____

_____

_____

_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____**, 20____**

Engineer: _____ **Date:** _____**, 20____**

(Authorized Signature)

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): Guideline K, Containers for Recovered Non-flammable Fluorocarbon Refrigerants.
2. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
3. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.
4. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
   a. Part 61—National Emission Standards for Hazardous Air Pollutants.
   b. Part 82—Protection of Stratospheric Ozone.
   c. Part 273—Standards for Universal Waste Management.

1.02 DEFINITIONS

A. ACM: Asbestos-containing material.

B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof and properly disposing of material. Demolish shall be synonymous with Remove unless otherwise noted. Demolition also includes removal of pipes, manholes, tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities, unless otherwise specified.

C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.

E. Renovation: Altering a facility or one or more facility components in any way.

F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.03 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

1.04 SEQUENCING AND SCHEDULING

A. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Facilities:

1. Structures and adjacent designated areas scheduled for complete demolition are as shown.
2. Portions structures and other areas scheduled for selective demolition, partial demolition, and renovation Work are as shown.

B. Structures:

1. Existing above-grade structures indicated shall be removed to 3 feet below grade, unless shown otherwise.
2. Interior walls, other than retaining walls and partitions, shall be removed to 3 feet below grade or to top of concrete slab on ground.
3. Partition walls shall be removed as shown.
4. Sidewalks, curbs, gutters and street light bases shall be removed as indicated. Adjacent structures and utilities to remain shall be protected.

C. Utilities and Related Equipment:

1. Notify Engineer or appropriate utilities to turn off affected services at least72 hours before starting demolition activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on the Drawings, notify Engineer immediately prior to further work in that area.
4. Remove meters and related equipment and deliver to a location determined by the Owner.
5. Excavate and remove utility lines serving structures to be demolished to a distance of 10 feet beyond the outside perimeter of the demolition.
6. Provide a permanent leak-proof closure for water and gas lines.
7. Plug sewer lines with concrete to a minimum plug length of 3 feet to prevent groundwater infiltration.

D. Paving and Slabs:

1. Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated to a depth of 18 inches below new finish grade.
2. Provide neat sawcuts at limits of pavement or concrete slab removal as indicated.

E. Concrete: Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Where new concrete adjoins existing, the new Work shall abut or tie into the existing construction.

F. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include: Fill holes and depressions left as a result of removals in existing masonry and concrete walls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

G. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of1 inch below final finished surface. Fill remaining embedded conduits with grout and patch surface of structure.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse: Remove raceways and cap ends. Demolish raceways at power source similar to raceway demolition at demolished structure. Remove cabling from raceway.
6. All existing equipment shown to be demolished shall have the conductors removed the from the source to the load.
7. Inaccessibly Concealed: Cut off and abandon in place.
8. Exposed or Concealed Above Accessible Ceilings: Remove.
9. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
10. Relocating Equipment: Extend existing wiring or run new wiring from the source.
11. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
12. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
13. Provide new typewritten panelboard circuit directory cards.

H. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

I. Dust and Debris Control:

1. Prevent the spread of dust and debris and avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
2. Sweep pavements at least once per week to control the spread of debris that may result in foreign object damage potential to vehicular traffic.

J. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades with flashing lights. Traffic controls shall be maintained by Contractor throughout construction period.

K. Existing Work:

1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
5. Do not overload pavements to remain.

L. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times. Where removal of existing roofing is necessary to accomplish the Work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent loss.

M. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.
3. Protect all facility elements not scheduled for demolition.
4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

N. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner’s personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner’s personnel and the general public to occupied portions of the structure.

3.02 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.03 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.04 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations, open basements and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 23, Fill and Backfill.

3.05 TITLE TO MATERIALS

A. All salvaged equipment and materials will remain the property of Owner.

B. All items designated to be removed shall become the property of Contractor.

C. Title to equipment and materials resulting from demolition is vested in the Contractor upon approval by Engineer of Contractor's Demolition/Renovation Plan, and the resulting authorization by Engineer to begin demolition.

3.06 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor's Demolition/Renovation Plan by Engineer.

B. Salvage equipment to the maximum extent possible.

C. Repair or replace, at the discretion of Engineer, items damaged during removal or storage.

3.07 REUSE OF MATERIALS AND EQUIPMENT

A. Remove and store materials and equipment listed in Article Title To Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.

B. Properly store and maintain equipment and materials in same condition as when removed.

C. Store equipment and material designated to be reused in a location designated by Owner.

D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.

E. Engineer will determine condition of equipment and materials prior to removal.

3.08 UNSALVAGEABLE MATERIAL

A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed at a permitted facility by the Contractor.

3.09 CLEANUP

A. Debris and rubbish shall be removed from basement and similar excavations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

SECTION 03 30 10
STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 GENERAL

A. Work shall conform to requirements of ACI 301, Specifications for Structural Concrete, unless otherwise specified.

1.02 REFERENCES

A. In accordance with ACI 301 and the following::

1. American Concrete Institute (ACI):
   a. 301, Specifications for Structural Concrete.
   b. 305.1, Specification for Hot Weather Concreting.
   c. 306.1, Specification for Cold Weather Concreting.
   d. 308.1, Specification for Curing Concrete.
   e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
   f. SP-66, Detailing Manual.
2. ASTM International (ASTM):
   a. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
   b. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
3. Concrete Reinforcing Steel Institute (CRSI):
   a. Manual of Standard Practice.
   b. Placing Reinforcing Bars.
   c. ANSI/CRSI – RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete.
4. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
5. National Ready Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cold joints, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

D. Hot Weather: As defined in ACI 305.1.

E. Hydraulic Structure: Liquid containment structure.

F. New Concrete: Concrete less than 60 days old.

G. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
    b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
        1) Bending lists.
        2) Placing drawings.
    c. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
    d. Construction Joints, Expansion Joints, and Control Joints: Layout and location for each type.
2. Mix Design:
    a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
    b. Documentation of average strength for each proposed mix design in accordance with ACI 301.

c. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common product Requirements, for the following:
   1) Portland cement.
   2) Fly ash.
   3) Slag cement.
   4) Aggregates, including specified class designation for coarse aggregate.
   5) Admixtures.
   6) Concrete producer has verified compatibility of constituent materials in design mix.

d. Test Reports:
   1) Cement: Chemical analysis report.
   2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
   3) Aggregates:
      a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
      b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
   4) Water-Soluble Chloride-Ion Content in Hardened Concrete: One of the following:
      a) Test report in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
      b) Calculation of water-soluble chloride content based on certified chloride content of each constituent material and proportion of constituent material in concrete mixture.
      c) All of the following:
         (1) Manufacturer’s Certificate of Compliance that each admixture does not intentionally add chlorides and/or that the chloride content of each admixture does not exceed trace amounts.
         (2) Verification that potable water is used in the concrete mix or test data documenting the chloride content of the water.
         (3) Letter from the concrete supplier stating that fine and coarse aggregates are from sources that are not known to be susceptible to chlorides in the aggregates.
   5) Alkali Aggregate Reactivity: Where required, in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

e. Product Data:
   1) Admixtures: Manufacturer’s product data sheets for each admixture used in proposed mix designs.

3. Samples: PVC waterstop splice, joint, and fabricated cross of each size, shape, and fitting of waterstop.
4. Letter stating compatibility between liquids being contained and materials used for waterstops and joint fillers.
5. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
   a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
   b. Documentation of embeds that must be at a temperature above freezing prior to placement of concrete.
   c. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   d. Methods for temperature protection during placement.
   e. Types of covering, insulation, housing, or heating to be provided.
   f. Curing methods to be used during and following protection period.
   g. Use of strength accelerating admixtures.
   h. Methods for verification of in-place strength.
   i. Procedures for measuring and recording concrete temperatures.
   j. Procedures for preventing drying during dry, windy conditions.
6. Detailed plan for hot-weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
   a. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   b. Use of retarding admixture.
   c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
   d. Types of shading and wind protection to be provided.
   e. Curing methods, including use of evaporation retardant.
   f. Procedures for measuring and recording concrete temperatures.
   g. Procedures for preventing drying during dry, windy conditions.
7. Concrete repair techniques.

B. Informational Submittals:

1. Preinstallation Conference minutes.
2. Manufacturer’s application instructions for bonding agent and bond breaker.
3. Manufacturer’s Certificate of Compliance to specified standards:
   a. Bonding agent.
   b. Bond breaker.
   c. Repair materials.
4. Statement of Qualification:
   a. Batch Plant: Certification as specified herein.
   b. Mix designer.
   c. Installer.
   d. Testing agency.
5. Manufacturer’s written instructions for product shipment, storage, handling, installation/application, and repair for:
   a. Waterstop.
   b. Joint filler and primer.
   c. Preformed control joint.
6. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at Site.
   b. In accordance with ASTM C94/C94M, including Requirement 14.2.1. through Requirement 14.2.10.
   c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor’s Licensed Design Engineer.
3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.

4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
    a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician–Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician–Grade II.

B. Preinstallation Conference:

1. Required Meeting Attendees:
    a. Contractor, including pumping, placing and finishing, and curing subcontractors.
    b. Ready-mix producer.
    c. Admixture representative.
    d. Testing and sampling personnel.
    e. Steel Reinforcement Installer
    f. Owner and/or Owner’s designee.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Owner of location and time.
3. Agenda shall include:
    a. Admixture types, dosage, performance, and redosing at Site.
    b. Mix designs, test of mixes, and Submittals.
    c. Placement methods, techniques, equipment, consolidation, and form pressures.
    d. Slump or slump flow and placement time to maintain slump and slump flow.
    e. Finish, curing, and water retention.
    f. Steel reinforcement details.
    g. Protection procedures for weather conditions.
    h. Other specified requirements requiring coordination.
4. Conference minutes as specified in Section 01 31 19, Project Meetings.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials:

1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
2. For unexposed areas, use new shiplap or plywood.
3. Earth cuts may be used for forming footings.

B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Ties:

1. Material: Steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Form Ties with Water Stop: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
   a. Integral steel waterstop 0.103-inch thick and 0.625-inch diameter tightly and continuously welded to tie.
   b. Neoprene waterstop 3/16-inch thick and 15/16-inch diameter whose center hole is one half diameter of tie or molded plastic water stop of comparable size.
   c. Orient waterstop perpendicular to tie and symmetrical about center of tie.
   d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

2.02 CONCRETE

A. Materials:

1. Cementitious Materials:
   a. Cement:
      1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
      2) Blended Hydraulic Cement:
         a) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
         b) Portland cement used in blended hydraulic cement; conform to requirements of ASTM C150/C150M.
      3) Furnish from one source.
   b. Supplementary Cementitious Materials (SCM):
      1) Fly Ash (Pozzolan): Class F and Class C fly ash in accordance with ASTM C618, except as modified herein:
         a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
      2) Slag Cement: In accordance with ASTM C989/C989M, Grade 100 or Grade 120.
2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
   a. Aggregates:
      1) In accordance with ASTM C33/C33M, except as modified herein.
         a) In accordance with ACI 301, except as modified herein.
         b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
         c) Aggregates that are susceptible to alkali-carbonate reactions shall not be used.
         d) Alkali Silica Reactivity: See Article Concrete Mix Design.
      2) Fine Aggregates:
         a) In accordance with ASTM C33/C33M, except as modified herein.
         b) In the event manufactured sand is included in the mix design, the material shall be from the same source as the coarse aggregate.

c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
(1) Limit material finer than 75-µm (No. 200) sieve to 3 percent mass of total sample.
(2) Limit coal and lignite to 0.5 percent.

3) Coarse Aggregate:
a) Crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles as determined by ASTM D4791.
b) Class designation in accordance with ASTM C33/C33M, Table 3: 4S unless otherwise specified.
c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

3. Admixtures:
a. Characteristics:
1) Compatible with other constituents in mix.
2) Contain at most, only trace amount chlorides in solution.
3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
4) Do not use calcium as an admixture.
b. Air-Entraining Admixture: ASTM C260/C260M.
c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
d. Retarding Admixture: ASTM C 494/C 494M, Type B.
e. Accelerating Admixture: ASTM C 494/C 494M, Type C.
f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
g. Shrinkage Reducing Admixture:
1) ASTM C494/C494M, Type S.
2) Manufacturers and Products:
a) Master Builders Solutions US, Shakopee, MN; MasterLife SRA 035.
b) Euclid Chemical Co., Cleveland, OH; Eucon SRA Series.
c) GCP Applied Technologies., Cambridge, MA; Eclipse Series.
h. Crack reducing admixture:
1) ASTM C494/C494M, Type S.
2) Manufacturers and Products:
a) Master Builders Solutions US., Shakopee, MN; MasterLife CRA007.

i. Do not use calcium chloride as an admixture.
j. Admixtures with no standard, ASTM or other, designation may be used where permitted.

4. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
   a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
      1) Chloride Content: 500 ppm.
      2) Sulfate Content as SO_4: 3,000 ppm.
      3) Alkalis as (Na_2O + 0.658 K_2O): 600 ppm.
      4) Total Solids by Mass: Less than 50,000 ppm.

B. Concrete Mix Design:

1. General:
   a. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
   b. Unless otherwise specified, prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
   c. Unless otherwise specified, selection of constituent materials and products in mix design are optional, unless specified otherwise.
   d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture, or plasticizing admixture for the following:
      1) Concrete mixtures that will be pumped.
      2) Concrete mixtures with a water-cementitious materials ratio below 0.50.
      3) Concrete mixtures used in elements of liquid-containment structure.
      4) Concrete mixtures used in columns, piers, pilasters, and walls.
      5) When needed to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
      6) When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.

e. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.

f. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials, and aggregate packing.

2. Potential Alkali-Aggregate Reactivity of Concrete:

a. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).

b. Unless otherwise specified, or unless members are assigned to Exposure Class C0, use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction. Option 3) shall not be used with natural pozzolans, or fly ash that has a CaO content more than 18 percent, or for aggregates with expansions greater than or equal to 0.24 percent when tested in accordance with ASTM C1293. Fly ash with an alkali content greater than 4.0 percent shall not be used in option 2) or 3).

1) For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 shall not exceed 0.04 percent at 1 year.

2) For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 shall not exceed 0.10 percent at an age of 16 days. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent at 16 days when tested in accordance with ASTM C1260.

3) Alkali content in concrete (LBA), excluding that from supplementary cementitious materials and the pozzolans and slags in blended cements, shall not exceed 4 lb/yd^3 for aggregates with expansions more than or equal to 0.04 percent and less than 0.12 percent or 3 lb/yd^3 for aggregates with expansions greater than or equal to 0.12 percent and less than 0.24 percent. Reactivity shall be determined by testing in accordance with ASTM C1293. Alkali content shall be calculated as follows:

a) LBA = (cement content, lb/yd^3) × (equivalent alkali content of portland cement in percent/100 percent).

3. Proportions:
    a. Design mix to meet aesthetic, durability, and strength requirements.
    b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.
4. Slump:
    a. Unless otherwise specified, and prior to submitting mix design, select a target slump at the point of delivery for concrete mixtures used for Work. Selected target slump shall not exceed 9 inches.
    b. Concrete shall not show visible signs of segregation.
    c. The target slump indicated on the submittal shall be used as the basis for acceptance during the project. Determine the slump by ASTM C143/C143M.
    d. Slump tolerance shall meet requirements of ACI 117.
5. Self-Consolidating Concrete:
    a. Unless otherwise specified, select a target slump flow at the point of delivery for self-consolidating concrete mixtures.
    b. Selected target slump flow shall not exceed 30 inches.
    c. Concrete shall not show visible signs of segregation.
    d. The target slump flow value indicated on the submittal shall be used as the basis for acceptance during the Project.
    e. Determine slump flow in accordance with ASTM C1611/C1611M.
    f. Slump flow tolerances shall be in accordance with ASTM C94/C94M.
    g. If specified, evaluate during the mixture qualification stage, proposed concrete mixtures for passing ability in accordance with ASTM C1621/C1621M and for static segregation in accordance with C1610/C1610M to meet criteria indicated in Contract Documents.
6. Size of Coarse Aggregate:
    a. Unless otherwise specified, nominal maximum size of coarse aggregate shall not exceed:
        1) Three-fourths of minimum clear spacing between reinforcement.
        2) One-fifth of narrowest dimension between sides of forms.
        3) One-third of thickness of slabs or toppings.

7. Temperature Limits:
    a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set, plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
    b. For mass concrete sections, provide documentation that maximum concrete temperature in structure will not exceed 160 degrees F, and maximum temperature differential between center of section and external surfaces of concrete will not exceed 35 degrees F.
    c. Accelerating admixture may not be used in mass concrete sections unless the thermal control plan specifically addresses the concrete mixtures with the same accelerating admixture, at a dosage equal to or greater than being proposed for the mass concrete.

2.03 REINFORCING STEEL

A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.

B. Fabrication: Follow CRSI Manual of Standard Practice.

2.04 ANCILLARY MATERIALS

A. Bonding Agent:

1. Unless otherwise specified, in accordance with the following:
    a. ASTM C881/C881M, Type V.
    b. Two-component, moisture-insensitive, 100 percent solids epoxy.
    c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
    d. Manufacturers and Products:
        1) Master Builders Solutions, Shakopee, MN; MasterInject 1500.
        2) Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
        3) Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
        4) Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
   a. Dayton Superior Corporation, Miamisburg, OH; Sure Lift J6WB.
   b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Reinforcing Steel Accessories:

1. Plastic Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 1 Reinforcement Supports.
2. Stainless Steel Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 2 Reinforcement Supports, except legs shall be made wholly from stainless steel wire.
3. Precast Concrete Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Cementitious (Precast) Reinforcement Supports.
   a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
   b. Precast concrete bar supports shall be four square inches minimum, in plan.
   c. Precast concrete bar supports shall have tie wires.

D. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-coated, epoxy-coated, or plastic-coated wire.

E. Plastic Waterstop:

1. Extruded from elastomeric plastic compound of which basic resin shall be prime virgin polyvinyl chloride (PVC). Compound shall not contain scrapped material, reclaimed material, or pigment.
2. Specific Gravity: Approximately 1.37.
3. Shore Durometer Type A Hardness: Approximately 80.
4. Performance Requirements: COE Specification CRD-C-572.
5. Type Required in Contraction and Control Joints: 6 inches wide and parallel longitudinal ribs or protrusions on each side of strip center, as indicated on Drawings.
6. Type Required in Construction Joints: Flat ribbed with same dimensional properties as described above.
7. Corrugated or tapered type waterstops are not acceptable.
8. Thickness: Constant from center bulb (or center of waterstop), to outside stop edge.

9. Waterstop Weight: 1.60 pounds for 3/8 inch by 6 inches, minimum per foot.
10. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction.
11. Manufacturers and Products:
    a. Center Bulb Type:
        1) Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN: No. RB6-38H (6 inches by 3/8 inch).
        2) Greenstreak Plastic Products, St. Louis, MO; Catalog No. 03150/GRD: Style 732 (6 inches by 3/8 inch).
        3) Four Seasons Industries Durajoint, Garrettsville, OH; Catalog No. CSP-162: Type 9 (6 inches by 3/8 inch).
        4) BoMetals, Carrollton, GA; Catalog No. RCB-638LB (6 inches by 3/8 inch).
        5) Dacon Plastics LLC, Portland, OR, (903) 245-0048; Catalog No. RCB17 (6 inches by 3/8 inch).
    b. Flat Ribbed Profile: Use same manufacturers as bulb type. caution

F. Hydrophilic Waterstop

1. For use at construction joints only, where new concrete is placed against existing concrete and as shown on Drawings.
2. Material shall be a nonbentonite hydrophilic rubber compound.
3. Manufacturers and Products:
    a. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.
    b. Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

G. Premolded Joint Filler:

1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
2. Sponge Rubber:
    a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum.
    b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.

H. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
2. Manufacturers and Products:
   a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
   b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
   c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
   d. Dayton Superior; Safe Cure and Seal 1315 EF.

I. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
   a. Master Builders Solutions, Shakopee, MN; MasterKure ER 50.
   b. Euclid Chemical Co., Cleveland, OH; Eucobar.

J. Nonshrink Grout:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
5. Pass fluid grout through flow cone with continuous flow 1 hour after mixing.
6. Minimum Strength of Fluid Grout:
   a. 3,500 psi at 1 day.
   b. 4,500 psi at 3 days.
   c. 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. Master Builders Solutions, Shakopee, MN; MasterFlow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.

K. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer’s Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be Site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer’s written recommendations.
6. Manufacturers and Products:
    a. Master Builders Solutions, Shakopee, MN; MasterEmaco S Series products.
    b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.

L. Crack Repair:

1. Obtain Letter of Certification from manufacturer’s technical representative, that products selected are appropriate for the specific applications.
2. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer’s written recommendations.
3. Use part epoxy injection resin for structural crack repairs.
    a. Manufacturers:
        1) Master Builders Solutions, Shakopee, MN; MasterInject Series.
        2) Euclid Chemical Co., Cleveland, OH.; Euco Series (#452).
        3) Sika Chemical Corp., Lyndhurst, NJ.; Sikadur Series.
4. Use hydrophilic polyurethane injection resin for non-structural crack repairs.
    a. Manufacturers:
        1) Master Builders Solutions, Shakopee, MN; MasterInject 1210 IUG.
        2) Euclid Chemical Co., Cleveland, OH.; Dural Aqua-Fil.
        3) Sika Chemical Corp., Lyndhurst, NJ.; SikaFix HH Hydrophilic.
        4) Prime Resins, Inc., Conyers, GA.; Prime Flex 900 XLV.

2.05 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Owner shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 FORMWORK

A. Form Construction:

1. Construct forms and provide smooth-form finish.
2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
4. Brace as required to prevent distortion during concrete placement.
5. On exposed surfaces, locate form ties in uniform pattern or as shown.
6. Construct so ties remain embedded in the member with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

B. Form Removal:

1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
   a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
   b. Curing and protection operations are maintained.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, in accordance with ACI 301.

B. Accessories:

1. Bar Supports in Contact with Ground: Provide precast concrete block supports.
   a. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.

2. Bar Supports in Contact with Forms: Unless otherwise noted, bar supports shall be plastic protected wire bar supports, stainless steel protected wire bar supports, or precast concrete block bar supports.
    a. Use stainless steel protected wire bar supports or precast concrete block bar supports at formed surfaces that will receive abrasive blasting, hydro-blasting, or grinding.
3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.

C. Splices and Laps:

1. Lap Splice Reinforcing: Refer to Structural General Notes on Drawings for additional information.
2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 INSTALLATION OF WATERSTOPS

A. General:

1. Continuous waterstop, as specified, shall be installed in all construction joints in walls and slabs of water holding basins and channels and in walls of belowgrade structures, unless specifically noted otherwise.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint.
4. Secure waterstop in correct position. Tie waterstop to reinforcing steel using grommets, hog rings, or tie wire at maximum spacing of 12 inches. Do not displace waterstop during concrete placement.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
    a. Ensure space beneath plastic waterstop is completely filled with concrete.
    b. Make visual inspection of waterstop area during concrete placement.
    c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.

8. Hydrophilic Waterstop:
    a. Prepare concrete surfaces and install in accordance with waterstop manufacturer's written instructions and the following:
        1) Surface Preparation:
            a) Concrete surface must be smooth, clean, and dry. Grind concrete as required.
            b) Clean debris, dirt, dust, and foreign material from concrete surface.
        2) Installation:
            a) Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of steel reinforcement, locate centered between layers of steel or as shown.
            b) Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
            c) Lap ends of waterstop strip together at splices and corners and join with sealant.
            d) Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.
            e) Lap hydrophilic waterstop 2 feet minimum with intersecting plastic waterstops.

3.04 CONCRETE PLACEMENT INTO FORMWORK

A. Inspection: Notify Owner and Special Inspector at least 1 work day in advance before starting to place concrete.

B. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use means and methods that prevent segregation.
5. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.

6. Joints in Footings and Slabs:
    a. Ensure space beneath plastic waterstop completely fills with concrete.
    b. During concrete placement, make visual inspection of entire waterstop area.
    c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
    d. Apply procedure to full length of waterstop.
7. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.

C. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Wipe clean with device that does not allow mortar to adhere to belt.
4. Cover conveyor belts and chutes.

D. Retempering: Not permitted for concrete where cement has partially hydrated.

E. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

F. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
2. Locate expansion, control, and contraction, joints where shown.
3. Construction Joints:
    a. Unless otherwise shown or permitted, locate construction joints as follows:
        1) Locate construction joints as shown on Drawings or where approved in the joint location submittal.
        2) Locate expansion, control, and contraction joints where shown on Drawings.

3) Provide vertical construction joints at maximum spacing of 40 feet unless shown or approved otherwise.
4) When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
5) Uniformly space vertical construction joints within straight sections of walls, avoiding penetrations.

4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

G. Minimum Time between Adjacent Placements:

1. Typical Unless Noted Otherwise: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
2. Expansion or Contraction Joints: 1 day.
3. If continuous placement of beams, girders, or slabs with columns or walls is indicated in Contract Documents, do not place horizontal elements until the underlying concrete is consolidated and bleed water is not on the surface of the supporting member, unless otherwise specified.

3.05 CONSOLIDATION AND VISUAL OBSERVATION

A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.06 COLD WEATHER PLACEMENT

A. Unless otherwise permitted, shall be in accordance with requirements of ACI 301, ACI 306.1, and as follows:

1. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
2. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Owner.
3. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
4. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.

5. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
6. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.

B. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.

C. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.

D. Cure as specified.

3.07 HOT WEATHER PLACEMENT

A. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:

1. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
2. Internal concrete temperature in structure shall not exceed 158 degrees F, and maximum temperature differential between center of section and external surfaces of concrete shall not exceed 35 degrees F.
3. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
4. Cure as specified.

3.08 CONCRETE BONDING

A. Construction Joints at Existing Concrete:

1. Thoroughly clean and roughen existing concrete surfaces to roughness profile range between CSP 7 to CSP 9 when verified by comparison to PC1-10.
2. Saturate surface with water for 24 hours prior to placing new concrete.

3.09 PREMOLDED JOINT FILLER INSTALLATION

A. Sufficient in width to completely fill joint space where shown.

B. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.

C. Secure premolded joint filler in forms before concrete is placed.

3.10 FINISHING FORMED SURFACES

A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.

B. Tie Holes: Unless otherwise specified, fill with specified repair material.

C. Prepare substrate and mix, place, and cure repair material per manufacturer’s written recommendations.

D. Repair defective areas of concrete.

1. Cut edges perpendicular to surface at least 1/2 inch deep. Do not feather edges. Soak area with water for 24 hours.
2. Patch with specified repair material.
3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Owner prior to use.
4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Owner.
5. Obtain quantities of repair material and manufacturer’s detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Owner.

E. Inject cracks that meet the definition of defective area.

1. When crack repair is deemed by Owner as requiring a structural repair, use part epoxy injection resin.
2. When crack repair is deemed by Owner as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.11 FINISHING UNFORMED SURFACES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Do not dust surfaces with dry materials nor add water to surfaces.
4. Cure concrete as specified.

B. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Steel gauge block 5/16 inch thick.
4. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
5. Thickness: Maximum 1/4 inch minus or 1/2 inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.

C. Exterior Slab Finish:

1. Provide broom finish unless specified otherwise.
2. Finish exposed edges with steel edging tool.
3. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.12 EXPOSED METAL OBJECTS

A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.

B. Repair area of chipped-out concrete as specified for defective areas.

3.13 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

A. Where shown, install in accordance with requirements of Drawings.

3.14 PROTECTION AND CURING

A. Protect and cure concrete in accordance with requirements of ACI 301, ACI 308.1, and as follows:

1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
2. Continuously wet cure concrete surfaces of hydraulic structures for a 7-day period. Intermittent wetting is not acceptable.
3. Use curing compound only where approved by Owner.
4. Cure formed surfaces with curing compound applied in accordance with manufacturer’s written instructions as soon as wet curing and finishing are completed.
5. Remove and replace concrete damaged by freezing.
6. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.15 NONSHRINK GROUT

A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer’s written instructions.

B. Grouting Machinery Foundations:

1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer’s written instructions.
2. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.
3. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
4. Form with watertight forms at least 2 inches higher than bottom of plate.
5. Fill space between bottom of machinery base and original concrete in accordance with manufacturer’s written instructions.

3.16 BACKFILL AGAINST STRUCTURES

A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.

B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.

C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.17 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. General:

1. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.
2. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.
3. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours and for additional time as may be required before transporting to test lab.
4. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
5. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
    a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
6. Evaluation will be in accordance with ACI 301 and Specifications.
7. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
8. Frequency of testing may be changed at discretion of Owner.

9. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M.
10. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Owner.
4. Segregation Test Objective: Concrete shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump or slump flow test.
    a. Test Procedure: Make slump or slump flow test and check for excessive slump or slump flow. Observe to see if mortar or moisture flows from slumped concrete.
    b. Reject concrete if mortar or moisture separates and flows out of mix.

C. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
    a. Six extra test cylinders from last 100 cubic yards of concrete.
    b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.

5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal.

D. Slab Finish Tolerances and Slope Tolerances:

1. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
2. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.18 MANUFACTURER'S SERVICES

A. Provide representative at Site for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

B. Concrete Producer Representative:

1. Observe how concrete mixes are performing.
2. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
3. Establish control limits on concrete mix designs.
4. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump or slump flow, and air content when specified.

C. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

D. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.19 SUPPLEMENTS

A. Requirements of concrete mix designs following "End of Section," are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:

1. Concrete Mix Design, CMD-1.
2. Concrete Mix Design, CMD-2.
3. Concrete Mix Design, CMD-3.

END OF SECTION

CONCRETE MIX DESIGN, CMD-1

A. Mix Locations: Typical, unless otherwise specified.

B. Exposure Categories and Classifications: F3S1W2C2 as defined in ACI 318-19.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
2. Minimum concrete compressive strength (f'c) shall be 5,000 psi at 28 days.
3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
   a. Slabs to receive hard-troweled finish.
   b. Slabs to receive dry shake floor hardener.
   c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	**Air Content (%)***
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is ±1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
   a. Fly Ash and other Pozzolans: 25 percent.
   b. Slag Cement: 50 percent.
   c. Combined Fly Ash and other Pozzolans and Slag Cement: 50 percent, with fly ash and other pozzolans not exceeding 25 percent.
   d. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
      1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
      2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
6. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
   c. ASTM C595/C595M Types excluding Type IS (greater than 70),conforming to ASTM C595/C595M, and having (MS) designation.
7. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
   a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
   b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
   c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
   d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
   e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
   f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.
8. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CMD-2

A. Mix Locations:

1. Electrical duct banks.
2. Pipe encasements that are not cast monolithically with concrete base mats or slabs.
3. Where specified in Contract Documents.

B. Exposure Categories and Classifications: F1S1W0C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.50.
2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days.
3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
   a. Slabs to receive hard-troweled finish.
   b. Slabs to receive dry shake floor hardener.
   c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	**Air Content (%)***
3/8	6.0
1/2	5.5
3/4	5.0
1	4.5
1-1/2	4.5
2§	4.0
3§	3.5

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is ±1-1/2 percent. §Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.	

5. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      ASTM C595/C595M Types excluding Type IS (greater than 70), conforming to ASTM C595/C595M, and having (MS) designation.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CMD-3

A. Mix Locations: Concrete curbs and sidewalks.

B. Exposure Categories and Classifications: F3S1W1C2 as defined in ACI 318-14.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
2. Minimum concrete compressive strength (f'c) shall be 5,000 psi at 28 days.
3. Air-entraining admixtures are prohibited in concrete mixtures and total air content must not be greater than 3 percent, for slabs to receive hard-troweled finish.
4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	**Air Content (%)***
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is ±1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on the sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in a mix design, as follows:
   a. Fly Ash and other Pozzolans: 25 percent.
   b. Slag Cement: 50 percent.
   c. Combined Fly Ash and other Pozzolans and Slag Cement: 50 percent, with fly ash and other pozzolans not exceeding 25 percent.
   d. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
      1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
      2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
6. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
   c. ASTM C595/C595M Type IS (greater than 70), conforming to ASTM C595/C595M, and having (MS) designation.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete.
   b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   e. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   f. A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   g. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   h. A563, Standard Specification for Carbon and Alloy Steel Nuts.
   i. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   j. A967/A967M, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

k. E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements.
l. F436/F436M, Standard Specification for Hardened Steel Washers.
m. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Socket Head Cap Screws, and Studs for General Use.
n. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
o. F594, Standard Specification for Stainless Steel Nuts.
p. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
   a. Evaluation Reports for Concrete and Masonry Anchors.
   b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
   c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
   d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
   e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
   a. Manufacturer’s product description and installation instructions.
   b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
   c. Adhesive Anchor Installer Certification, where applicable for installation of horizontal or upwardly inclined anchors with sustained tension loads.
2. Passivation method for stainless steel members.
3. Hot-Dip Galvanizing: Certificate of Compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36
Flat and Beveled Washers (Hardened)	F436/F436M
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; KWIK Bolt-TZ2 Expansion Anchor Safe Set System with hollow drill bit and vacuum and SI-AT-A22 tool with adaptive torque for applicable sizes (ESR-4266).
   b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).

C. Self-Tapping Concrete Screw Anchors:

1. Manufacturers and Products:
   a. DeWalt/Powers Fasteners, Brewster, NY; Screw-Bolt + (ESR-3889).
   b. DeWalt/Powers Fasteners, Brewster, NY; Vertigo+ Rod Hanger Screw Anchor (ESR-2989).
   c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
   d. Hilti, Inc., Tulsa, OK; Kwik HUS-EZ (KH-EZ), KH-EZ CRC, KH-EZ SS316, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ P Screw Anchor Safe Set System with hollow drill bit and vacuum (ESR-3027).
   e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).

D. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer’s name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of When:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer’s instructions.
4. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT-HY 200 V3 Safe Set System with HIT-Z ROD HAS threaded rod (ESR 4868), HITRE 500 V3 Safe Set System with HAS threaded rod (ESR-3814), or HIT-RE 500 V3 Safe Set System with Hilti Roughening Tool (HIT RT) with HAS threaded rod (ESR 3814) for diamond cored holes.
   b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
   c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).

E. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

A. Begin installation only after concrete to receive anchors is a minimum of 21 days old or has attained design strength whichever requires a longer duration.

B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer’s instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer. Use rotary hammer drill unless otherwise approved by Engineer. Core drilling may only be used if specifically allowed by the Engineer.

F. Clean hole of debris and dust per manufacturer’s requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer’s installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

H. Adhesive Anchors:

1. Unless otherwise approved by Engineer and adhesive manufacturer:
   a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
   b. Do not install prior to concrete attaining an age of 21 days.
   c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   d. Do not disturb anchor during recommended curing time.
   e. Do not exceed maximum torque as specified in manufacturer’s instructions.
2. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without Engineer’s prior approval unless specifically shown on Drawings.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 MANUFACTURER'S SERVICES

A. Adhesive Anchors: Conduct Site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify Engineer of time and place for sessions.

3.04 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	**Product**	**Remarks**
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application

Service Use and Location	Product	Remarks
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
2. All Others		
All service uses and locations	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 05 23
WELDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions.
   c. D1.1/D1.1M, Structural Welding Code—Steel.
   d. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
   e. D1.2/D1.2M, Structural Welding Code—Aluminum.
   f. D1.3/1.3M, Structural Welding Code—Sheet Steel.
   g. D1.4/D1.4M, Structural Welding Code—Reinforcing Steel.
   h. D1.6/D1.6M, Structural Welding Code—Stainless Steel.
   i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor’s Welding Inspector: Contractor’s CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
2. Verification Inspector: This independent inspection is the prerogative of the Owner, who may employ their own, independent CWI, or waive this supplementary, independent CWI inspection.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. Special Inspection: Nondestructive examination including MT, PT, UT, and RT. Special Inspection personnel report to, and are retained by the Owner. See additional requirements in Section 01 45 33, Special Inspection, Observation, and Testing.

J. RT: Radiographic Testing.

K. UT: Ultrasonic Testing.

L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Shop and field WPSs and PQRs.
    b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
    c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
        1) Show on Shop Drawings, or on a weld map, complete information regarding base metal ASTM specifications, and location, type, size, and length of all welds.
        2) Identify WPS to be used, and NDE requirements in tail of welding symbols as indicated in AWS A2.4.

3) Clearly distinguish between shop and field welds.
4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
5) Welding and NDE Symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall comply with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency personnel credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms provided in referenced welding codes.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex J Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.

B. WPQs: In accordance with AWS D1.1/D1.1M (Annex J Forms); or ASME BPVC SEC IX (Form QW-484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Contractor’s CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job materials and proper storage.
2. Monitor conformance with approved WPSs.
3. Monitor conformance of WPQs.
4. Inspect weld joint fit-up and perform in-process inspections.
5. Provide 100 percent visual inspection of completed welds.
6. Coordinate with nondestructive testing personnel and review NDE results.
7. Maintain records and prepare reports documenting that results of CWI VT and required NDE complies with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor’s CWI.
2. Acceptance Criteria:
   a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 10.24.
   b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
   c. Stud Connections: AWS D1.1/D1.1M, Paragraph 9.8.1.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
   a. Nontubular Connections:
      1) CJP Butt Joint Groove Welds: 10 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      2) All Other CJP Groove Welds: 10 percent random UT.
      3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
   b. Tubular Connections:
      1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 10.25.2 requirements.
      2) CJP Butt Joint Groove Welds made with back-gouging: 10 percent random RT.
      3) CJP Butt Joint Groove Welds made with backing and other butt joint groove welds that cannot be readily radiographed: 10 percent random UT.
      4) All Other CJP Groove Welds: 10 percent random UT.
      5) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
2. NDT Procedures and Acceptance Criteria:
   a. Nontubular Connections:
      1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.12.1.
      2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.13.1.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
         b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.

b. Tubular Connections:
   1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.27 and Paragraph 10.28.
   2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.26, and Paragraph 10.29.
   3) PT and MT:
      a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
      b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 10.24.

3.03 FIELD QUALITY CONTROL

A. The Contractor's CWI shall be present whenever field welding is being done and shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job materials and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor conformance of WPQ.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
6. Coordinate with nondestructive testing personnel and review test results.
7. Maintain records and prepare reports confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal have been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Welding and Nondestructive Testing Table.

END OF SECTION

Welding and Nondestructive Testing						
Specification Section	**Governing Welding Codes or Standards**	**Submit WPS**	**Submit WPQ**	**Onsite CWI Required?**	**Submit Written NDT Procedure Specifications**	**NDT Requirements**
05 12 00 Structural Steel Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel	Yes	Yes	Yes	Yes	100% VT and 10% UT or RT of all groove-and-butt joint welds; 10% MT of all fillet welds; also see Section 05 12 00
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum or AWS D1.6/D1.6M, Structural Welding Code—Stainless Steel	Yes	Yes	Yes	No	100% VT; also see Section 05 50 00
05 53 00 Metal Gratings	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum	No	No	No	No	100% VT; also see Section 05 53 00

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Galvanizers Association (AGA): Quality Assurance Manual.
2. American Institute of Steel Construction (AISC):
   a. 201, Certification Program for Structural Steel Fabricators.
   b. 206, Certification Program for Structural Steel Erectors—Standard for Structural Steel Erectors.
   c. 303, Code of Standard Practices for Steel Buildings and Bridges.
   d. 325, Steel Construction Manual.
   e. 326, Detailing for Steel Construction.
   f. 341, Seismic Provisions for Structural Steel Buildings.
   g. 360, Specification for Structural Steel Buildings.
   h. 420, Certification Standard for Shop Application of Complex Protective Coating Systems.
3. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code—Steel.
   b. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
4. ASTM International (ASTM):
   a. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   b. A36/A36M, Standard Specification for Carbon Structural Steel.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   d. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   e. A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   g. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   h. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).

i. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
j. A563, Standard Specification for Carbons and Alloy Steel Nuts.
k. A572/A572M, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.
l. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
m. A992/A992M, Standard Specification for Structural Steel Shapes.
n. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
o. A1085/A1085M, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
p. ASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
q. ASTM D7803 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating.
r. F436, Standard Specification for Hardened Steel Washers.
s. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
t. F1136, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners.
u. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

5. Occupational Safety and Health Administration (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide Shop Drawing details showing:
   a. Erection plans.
   b. Members, including piece numbers, sizes, grades, dimensions, cambers, and connection details.
   c. Anchor bolt layouts.
   d. Hardened washer details.
   e. Connection material specifications.

f. Indicate type, size, and length of bolts.
g. Joint details for complete penetration welds.
h. Indicate welds by standard AWS symbols, distinguishing between shop and field welds and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

2. Product specifications, including primer and other coatings.
3. Identify pretensioned and slip-critical high strength bolted connections.
4. Locations of Class A, or higher, faying surfaces.
5. Weld access hole dimensions, surface profile, and finish requirements.
6. Location of demand critical shop welds.
7. Locations and dimensions of protected zones.
8. Gusset plates drawn to scale when they are detailed to accommodate inelastic rotation.
9. Nondestructive testing (NDT) where performed by the fabricator.
10. Welding requirements as specified in AISC 341 Appendix W, Section W2.2.

B. Informational Submittals:

1. Schedule for submittal of shop and erection drawings.
2. Name and address of manufacturer(s).
3. Mill Certificates of tests made in accordance with ASTM A6/A6M.
4. Manufacturers' testing procedures and standards.
5. Preparation and installation or application instructions, as appropriate.
6. Proposed method to resolve misalignment between anchor bolts and bolt holes in steel members.
7. High-Strength Bolts:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products meet specified chemical and mechanical requirements.
   b. Manufacturer's inspection test report results for production lot(s) furnished to include:
      1) Tensile strength.
      2) Yield strength.
      3) Reduction of area.
      4) Elongation and hardness.
   c. Certified Mill Test Reports for Bolts and Nuts:
      1) Name and address of manufacturer.
      2) Bolts correctly marked.
      3) Marked bolts and nuts used in required mill tests and manufacturer's inspection tests.

8. Direct Tension Indicators (DTIs): Manufacturer’s test report meeting requirements of ASTM F959.
9. Twist-Off-Type Tension-Control (TC) Bolts: Manufacturer’s test report meeting requirements of ASTM F3125 Grade F1852.
10. Welding Procedures, Qualifications, and Inspection Reports: As specified in Section 05 05 23, Welding.
11. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer with description of material processed and ASTM standard used for coating.
12. AISC Quality Certification: AISC certificate showing name and address of certified firm, effective date, and category of certification; or, for erectors, documentation of similar project experience to include project name, location, date of completion, and name and phone number of owner’s contact person.
13. Charpy V-notch test results.
14. Nondestructive Testing (NDT) report.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Welding qualifications as specified in Section 05 05 23, Welding.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of AGA’s Quality Assurance Manual.

B. Certifications:

1. Mill identification marks, heat number, size of section, and length in accordance with ASTM A6/A6M.
2. AISC Quality Certification for Fabricator: A fabricator who participates in the AISC Certification program and is designated an AISC certified plant, Category BU.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.

B. Storage:

1. Store materials to permit easy access for inspection and identification. Store in a dry area and keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   a. Do not store materials in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials as directed.
2. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   a. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and sealing of containers.
   b. Clean and lubricate bolts and nuts that become dry or rusty before use.
   c. Comply with manufacturer's written recommendations for cleaning and lubricating fasteners and for retesting fasteners after lubrication.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled Plates, Shapes except W-Shapes and Bars: ASTM A36/A36M, unless indicated otherwise.

B. W-Shapes: ASTM A992/A992M, unless indicated otherwise on Drawings.

C. Steel Pipe: ASTM A53/A53M, Grade B.

D. Round Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C (Fy equals 46 ksi).

E. Square and Rectangular Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C (Fy equals 50 ksi).

2.02 FASTENERS

A. Anchor Bolts: As specified in Section 05 50 00, Metal Fabrications.

B. Post-Installed Anchors: As specified in Section 05 05 19, Post-Installed Anchors.

C. High-Strength Bolts:

1. ASTM F3125 Grade A325, Type 1, hot-dip galvanized.
2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.

D. Direct Tension Indicators (DTIs) or Load Indicator Washers:

1. ASTM F959, coating type to match bolt finish.
2. Type A325 or A490, to match bolt grade.
3. Manufacturers and Products:
   a. TurnaSure LLC, Langhorne, PA; DTIs.
   b. Applied Bolting Technology Products, Ludlow, VT; DTIs, regular or Squirter type.

E. Twist-Off-Type Tension-Control (TC) Bolts:

1. High-strength, ASTM F3125 Grade F1852, bolt Type1, mechanically galvanized.
2. Manufacturers:
   a. LeJeune Bolt Company, Burnsville, MN.
   b. Nucor Fastener, Saint Joe, IN.
   c. Haydon Bolts, Philadelphia, PA.
   d. Vermont Fasteners Manufacturing, Swanton, VT.

F. Nuts: ASTM A563, type to match bolt type and finish.

G. Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

H. Stud Shear Connectors: As specified in Section 05 50 00, Metal Fabrications.

2.03 ANCILLARY MATERIALS

A. Surface Preparation and Primer: As specified in Section 09 90 00, Painting and Coating.

B. Grout: As specified in Section 03 30 10, Structural Concrete.

2.04 FABRICATION

A. General:

1. Fabricate as shown and in accordance with AISC 360 and AISC 303.
2. Columns: Full-length members without splices, unless shown otherwise or approved by Engineer.
3. Mark and match mark materials for field assembly.

4. Complete assembly, including bolting and welding of units, before start of finishing operations.
5. Fabricate to agree with field measurements.
6. Fabricate beams with rolling camber up.
7. Sheared and flame-cut edges shall be free from rough corners and projections.

B. Connections:

1. Shop Connections: Weld or bolt as shown on Drawings.
2. Meet requirements of AISC 325 for bolted double-angle shear connections, unless indicated otherwise.
3. Meet OSHA requirements for one independent bolt at beams framing in to column web connections.
4. Provide oversized holes for anchor bolts in column baseplate in accordance with AISC 325, Table 14-2, unless indicated otherwise.

C. Welded Construction:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

D. Interface with Other Work:

1. Holes:
   a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members shall be approved by Engineer.
   b. No flame-cut holes are permitted without prior approval of Engineer.
2. Weld threaded nuts to framing members, and other specialty items to receive other Work.

2.05 FINISHES

A. Shop Paint Primer:

1. Surface Preparation and painting as specified in Section 09 90 00, Painting and Coating.
2. Do not shop prime the following surfaces, unless indicated otherwise:
   a. Within 2 inches of field-welded connections.
   b. Steel members to be completely encased in reinforced concrete or coated with cementitious fireproofing.
3. Apply shop primer to top flange surfaces of composite steel beams, unless indicated otherwise.

B. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of steel.
2. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
3. Remove, by blast cleaning or other methods, surface contaminants and coatings not removable by normal chemical cleaning process in galvanizing operation.
4. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
5. Hot-dip galvanize ASTM F3125 Grade A325 bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop-assemble bolts, nuts, and washers with special lubricant and test in accordance with ASTM A325 F3125 and ASTM A563.
6. Mechanically zinc coat ASTM F3125 Grade F1852 twist-of-type tension-control (TC) bolts, nuts, and washers in accordance with ASTM F3125 and ASTM B695, Class 50.
7. Coat ASTM F3125 Grade F2280 twist-off-type tension-control (TC) bolts, nuts, and washers in accordance with ASTM F1136.
8. Galvanize components of bolted assemblies separately before assembly.

C. Slip Critical Bolted Connections:

1. Coated Faying Surfaces: Coat faying surfaces of slip critical bolted connections specified or shown with a paint primer with a Class A or Class B coating in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts and as specified in Section 09 90 00, Painting and Coating. Protect against overspray by use of masking. Remove inadvertent overspray from the faying surfaces.
2. Galvanized Faying Surfaces: Roughen galvanized surfaces of slip critical bolted connections by hand wire brushing in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts as a Class C faying surface.

2.06 SOURCE QUALITY CONTROL

A. Welding:

1. Contractor’s Certified Welding Inspector (CWI): Inspect and test fabrication welds as specified in Section 05 05 23, Welding.

2. Visually inspect fabrication welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. An independent testing agency will be retained by Owner to perform the inspection and testing of fabrication welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

B. Hot-Dip Galvanizing:

1. An independent testing agency will be retained by Owner to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.01 ERECTION

A. General:

1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.
2. Install Contractor-designed temporary construction bracing to provide necessary support until components are in place and construction is complete.
3. Provide additional field connection material as required by AISC 303.
4. Splice members only where indicated and accepted on Shop Drawings.

B. Field Assembly:

1. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.
2. Set structural frames accurately to lines and elevations shown.
3. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.
4. Level and plumb individual members of structure within tolerances shown in AISC 303.

5. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be completed and in service.
6. Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

C. Setting Baseplates and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.
2. Clean bottom surface of baseplates and bearing plates.
3. Set loose and attached baseplates and bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated.
4. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washer to baseplate where indicated.
5. Grout Under Baseplate: Prior to placing loads on structure.

D. Anchor Bolts:

1. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.
2. Provide templates and other devices for presetting bolts and other anchors to accurate locations.
3. Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.
4. Placement Tolerances:
    a. As required by AISC 303, unless indicated otherwise.
    b. Embedded anchor bolts shall not vary from dimensions shown on Drawings by more than the following:
        1) Center-to-Center of Any Two Bolts Within an Anchor Group: 1/8 inch.
        2) Center-to-Center of Adjacent Anchor Bolt Groups: 1/4 inch.
        3) Variation from Perpendicular to Theoretical Bearing Surface: 1:50.

E. Connections:

1. High-Strength Bolted:
   a. Tighten in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
   b. Pretension all bolts unless noted otherwise on Drawings.
   c. Hardened Washers:
      1) Provide at locations required by Washer Requirements section of RCSC Specification for Structural Joints Using High Strength Bolts, to include pretensioned and slip critical connections using slotted or oversized holes or ASTM A490 bolts.
      2) Use beveled style and extra thickness where required by RCSC Specification.
      3) Use square or rectangular beveled washers at inner flange surfaces of American Standard beams and channels.
      4) Do not substitute DTIs for hardened flat washers required at slotted and oversize holes.
   d. For snug-tightened connections (N, X), tighten to snug tight condition. Use hardened washer over slotted or oversize holes in outer plies.
2. Pretensioned Bolted:
   a. Use DTIs or twist-off-type tension-control (TC) bolts at slip critical (SC) and pretensioned bearing-type connections.
   b. DTIs:
      1) Position within bolted assembly in accordance with ASTM F959.
      2) Install bolts, with DTIs plus hardened washers as required, in holes of assembly and tighten until plies are in firm contact and fasteners are uniformly snug tight.
   c. Final tightening bolts begin at most rigid part of bolted connection and progress toward free edges until final twist-off-type tension-control (TC) bolts or until DTIs have been compressed to an average gap equal to or less than shown in ASTM F959, Table 2.
3. Welded:
   a. As specified in Section 05 05 23, Welding.
   b. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

3.02 MISFITS

A. At Bolted Connections:

1. Immediately notify Engineer for approval of one of the following methods of correction:
   a. Ream holes that must be enlarged to admit bolts and use oversized bolts.
   b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
   c. Drill additional holes in connection, conforming to AISC for bolt spacing and end and edge distances, and add additional bolts.
   d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.
2. Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

B. At Anchor Bolts:

1. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved Shop Drawing.
2. Do not flame cut to enlarge holes without prior approval of Engineer.

C. Gas Cutting:

1. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
2. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by Engineer.
3. Finish flame-cut sections equivalent to sheared and punched appearance.

3.03 REPAIR AND CLEANING

A. Clean shop primer from field welds, bolted connections, and abraded areas immediately after erection.

B. Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.

C. Remove weld back-up bars and grind smooth where indicated on Drawings.

D. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application and as specified in Section 09 90 00, Painting and Coating.

E. Hot-Dip Galvanized Coating Repair:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.04 FIELD FINISH

A. Field finish in accordance with Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspect and test as required in Section 01 45 16.13, Contractor Quality Control.

C. High-Strength Bolted Connections:

1. An independent testing agency will be retained by Owner to perform the following inspection and testing in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts:
   a. Marking identification and conformance to ASTM standards.
   b. Alignment of bolt holes.
   c. Placement, type, and thickness of hardened washers.
   d. Tightening of bolts.
2. Snug-Tightened Connections (N, X): Snug tight condition with plies of joint in firm contact.
3. Pretensioned Bearing and Slip Critical (SC) Connections:
   a. Conduct preinstallation test.
   b. Monitor installation and tightening of DTIs or TC bolts.
   c. Monitor condition of faying surfaces for slip critical connections.
4. Preinstallation Test:
   a. Conduct test in accordance with Specification for Structural Joints Using ASTM F3125 Grade A325 or Grade A490 bolts prior to using bolt tension measuring device.

b. Select representative sample of not less than three bolts of each diameter, length, and grade.
c. Include DTIs and flat hardened washers as required to match actual connection assembly.

5. Nondestructive Testing (NDT): Inspect bolted connections and perform corrections as required to meet code acceptance criteria per RCSC Specification for Structural Joints Using High-Strength Bolts.
6. Defective Connections: Correct and reinspect defective and improperly tightened high-strength bolted connections. Retest pretensioned bolts as necessary to demonstrate compliance of completed work.

D. Welding:

1. Contractor’s Certified Welding Inspector (CWI): Inspect and test field welds as specified in Section 05 05 23, Welding.
2. Visually inspect field welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. An independent testing agency will be retained by Owner to perform inspection and testing of field welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Institute of Steel Construction (AISC):
   a. 201, Certification Program for Structural Steel Fabricators.
   b. 206, Certification Program for Structural Steel Erectors Standard for Structural Steel Erectors.
   c. 303, Code of Standard Practices for Steel Buildings and Bridges.
   d. 325, Steel Construction Manual.
   e. 326, Detailing for Steel Construction.
   f. 341, Seismic Provisions for Structural Steel Buildings.
   g. 360, Specification for Structural Steel Buildings.
   h. 420, Certification Standard for Shop Application of Complex Protective Coating Systems.
4. American Iron and Steel Institute (AISI): Stainless Steel Types.
5. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
6. American National Standards Institute (ANSI).
7. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
8. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
9. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
o. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
p. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
q. A489, Standard Specification for Carbon Steel Lifting Eyes.
r. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
s. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
u. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
v. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
w. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
x. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
y. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
z. A992/A992M, Standard Specification for Structural Steel Shapes.

aa. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
bb. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
cc. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
hh. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
ii. F436, Standard Specification for Hardened Steel Washers.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F594, Standard Specification for Stainless Steel Nuts.
mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
oo. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

10. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910.23, Ladders.
    b. 29 CFR 1910.28, Duty to Have Fall Protection and Falling Object Protection.
    c. 29 CFR 1910.29, Fall Protection Systems and Falling Object Protection-Criteria and Practices.
    d. 29 CFR 1926.105, Safety Nets.
    e. 29 CFR 1926.502, Fall Protections Systems Criteria and Practices.
11. Specialty Steel Industry of North America (SSINA):
    a. Specifications for Stainless Steel.
    b. Design Guidelines for the Selection and Use of Stainless Steel.
    c. Stainless Steel Fabrication.
    d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

C. Exterior Area: Location not protected from weather by building or other enclosed structure.

D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including welding and fastener information.
2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals:

1. U-Channel Concrete Inserts:
   a. Manufacturer’s product description.
   b. Allowable load tables.
2. Pre-engineered Ladders: Letter of certification that ladder meets OSHA 29 CFR 1910.27 23 requirements, ALI 14.3 requirements and specifications herein.
3. Passivation method for a members.
4. Galvanized coating applicator qualifications.
5. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. Unless otherwise indicated, meet the following requirements:

Item	**ASTM Reference**
Aluminum – Plates and Shapes:	
Plates	B209, Alloy 6061-T6
Shapes	B308/B308M, Alloy 6061-T6
Aluminum – Fasteners:	
Bolts	F468, Alloy 2024-T4
Nuts	F467, Alloy 2024-T4
Washers	

Item	ASTM Reference
Cast Iron:	
Cast Iron:	A48/A48M, Class 35
Stainless Steel – Plates and Shapes:	
Angles and Bars	A276, AISI Type 316 (316L for welded connections), 30 kips per square inch minimum yield stress
Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections), 30 kips per square inch minimum yield stress
Shapes – Rolled	A276, AISI Type 304 (304L for welded connections), 30 kips per square inch minimum yield stress A1069 (Laser-fused process), 30 kips per square inch minimum yield stress
Shapes – Built-up	A276, AISI Type 304 (304L for welded connections), 30 kips per square inch minimum yield stress A1069 (Laser-fused process)
Stainless Steel – Anchors and Fasteners:	
Anchor Bolts and Rods	F593, AISI Type 316, Group 2 Condition CW
Bolts	F593, AISI Type 316, Group 2 Condition CW
Nuts	F594, AISI Type 316, Condition CW
Threaded Rods	F593, AISI Type 316, Group 2 Condition CW
Washers	
Welded Anchor Studs	F593, AISI Type 316, Group 2 Condition CW
Steel – Plates and Shapes:	
Hollow Structural Sections (HSS) – Round	A500/A500M, Grade C
Hollow Structural Sections (HSS) – Square and Rectangular	A500/A500M, Grade C
Pipe which is Part of Structure	A500/A500M, Grade C
Plates and Other Shapes	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Wide Flange Shapes	A992/992M

Item	ASTM Reference
Steel – Anchors and Fasteners:	
Anchor Bolts and Rods	F1554, Grade 36, with weldability supplement S1.
Bolts	A307
High-Strength Bolts	F3125, Type 1
Eyebolts	A489
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Nuts	A563
Threaded Rods	A36/A36M
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Steel – Thrust Ties for Steel Pipe:	
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Threaded Rods	A193/A193M, Grade B7

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.
   b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
   c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.05 ABRASIVE NOSING FOR STAIRS

A. Unless otherwise shown on Drawings, furnish flush type abrasive nosings on stairs.

B. Nosing Components:

1. Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.
2. Epoxy abrasive shall extend over and form curved front edge of nosing.
3. Base of Nosing: Extruded aluminum alloy, 6063-T5, heat-treated.

C. Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.

D. Size: 3 inches wide by 1/4 inch to 3/8 inch thick by length as shown.

E. Color: Selected by Engineer from manufacturer’s standard color range.

F. Manufacturers and Products:

1. American Safety Tread Co., Inc., Helena, AL; Type BF-311D.

2.06 FLOOR PLATE

A. Material:

1. Galvanized Steel: Carbon steel, ASTM A786/A786M, commercial grade, hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
2. Stainless Steel: ASTM A793, AISI Type 304.
3. Aluminum: ASTM B632/B632M, Alloy 6061-T6.

B. Minimum Thickness:

1. Steel: 1/4 inch, unless shown otherwise on Drawings.
2. Aluminum: 3/8 inch, unless shown otherwise on Drawings.

C. Surface: Raised-lug pattern or diamond tread, unless shown otherwise on Drawings.

D. Slip-Resistant Surface:

1. Provide where indicated on Drawings.
2. Manufacturers and Products:
   a. IKG/Borden, Clark, NJ; MEBAC 2.
   b. W.S. Molnar Co., Detroit, MI; SLIPNOT Grade 2–Medium.

2.07 LADDERS

A. Fabricate ladders with rails, rungs, landings, and cages to meet applicable requirements of OSHA, 29 CFR Part 1910.2723, and ALI A14.3.

1. Design ladder for concentrated load of 200 pounds imposed by user concentrated at points that will cause maximum stress in structural member being considered.
2. Include weight of ladder and attached appurtenances together with live load in design of rails and fastenings.
3. Self-closing gates at landings.

B. Flat Bar Ladder:

1. Punch rails, pass rungs through rails, and weld on outside.
2. Weld brackets to ladder for fastening ladder to wall.
3. Unless otherwise noted, hot-dip galvanize steel after fabrication in accordance with ASTM A123/A123M and ASTM A385/A385M.
4. Where stainless steel is required, ASTM A276, AISI Type 316L stainless steel.

C. Aluminum Pre-engineered Pipe Ladder:

1. Rungs:
   a. Aluminum extrusions of Alloy 6063-T6.
   b. Nonslip grip surface, 1-inch wide flat top, and semicircular bottom with mill finish.
2. Side Rails: ASTM B429/B429M, Alloy 6063-T6, 1-1/2 inches, Schedule 40 pipe with anodized finish, AA M32-C22-A41.
3. Ladder Attachments and Cage Assembly Fasteners: Stainless steel.
4. Welded, pop riveted, or glued construction is not acceptable.

5. Fabricate to longest length as practical but not to exceed 24 feet.
6. Furnish support attachments to side rails at 6 feet maximum spacing.
7. Manufacturer: Thompson Fabricating Co. Inc., Tarrant, AL.

D. Ladder Safety Post:

1. Telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.
2. Post: Unless otherwise noted, material shall be same type as ladder construction.
   a. Hot-dip galvanized steel: In accordance with ASTM A123/A123M.
   b. Stainless steel: AISI Type 304.
   c. Aluminum: 6061-T6.
3. Hardware: Stainless steel, AISI Type 316.
4. Furnish dissimilar metal protective coatings at connections.
5. Manufacturer and Product: Bilco Co., New Haven, CT; “Ladder Up” to fit ladder rungs.

2.08 SAFETY CLIMB DEVICE

A. General:

1. Conforms to ALI A14.3 and OSHA 29 CFR Part 1910.27.
2. Belt and harness shall withstand minimum drop test of 250 pounds in 6-foot free fall.
3. Fall Prevention System Material: Stainless steel, AISI Type 316.

B. Components and Accessories:

1. Main Components: Sleeve or trolley, safety harness, and carrier or climbing rail.
2. Unless otherwise specified, material shall be the same type as ladder construction.
   a. Stainless steel: AISI Type 316, mounting brackets and hardware.
3. Removable extension kit with tiedown rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.

C. Manufacturers and Products:

1. Miller by Honeywell, Franklin, PA; Miller Saf-T-Climb.
2. TS Products, Cambridge, Ontario, Canada; TS Safety Rail System.

2.09 FALL ARREST ANCHORS

A. General:

1. Conforms to OSHA 29 CFR Part 1926.502.
2. Minimum Breaking Strength: 5,000 pounds.
3. Material: Stainless steel, AISI Type 304.

B. Components and Accessories:

1. Forged combination eye and base assembly with headed anchor bolt, backer plate, lock washer, and nut.
   a. Suitable for embedment in concrete wall or slab.
2. D-ring anchorage plate with zinc-plated steel D-ring and Type 304 stainless steel plate.

C. Manufacturers and Products:

1. Thaler Metal Industries, Buffalo, NY Mississauga, Ontario, Canada; FARA Wall Anchor.
2. Rose Manufacturing Company, Pittsburgh, PA; Anchorage Connector.
3. MSA Safety Incorporated, Cranberry Township, PA; 5K MEGA Swivel Anchorage Connector Kit, Stainless.

2.10 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.

3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.
4. Stainless Steel Built-up Shapes: Fabricate built-up shapes in accordance with ASTM A1069/A1069M.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer’s instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.

6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A653/A653M.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

H. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.11 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

B. Hot-Dip Galvanizing:

1. An independent testing agency, will be retained by Owner to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Install manufactured products in accordance with manufacturer’s recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.
5. Do not remove mill markings from concealed surfaces.
6. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
7. Snug-tighten bolts, unless otherwise specified.

B. Steel: Fabrication, erection, connections, bolted and welded construction shall be in accordance with AISC Steel Construction Manual and AWS D1.1.

C. Stainless Steel:

1. Fabrication, erection, connections, bolted and welded construction shall be in accordance with AWS D1.6 and the following SSINA standards:
   a. Specifications for Stainless Steel.
   b. Stainless Steel Fabrication.
   c. Stainless Steel Fasteners.
2. Do not field weld unless approved by Engineer in writing.

D. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and bolted construction shall be in accordance with the AA Aluminum Design Manual.

E. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ABRASIVE NOSINGS

A. Provide abrasive nosings on concrete steps not being supplied or coated with another type of nosing or nonskid material.

3.04 SAFETY CLIMB DEVICE SYSTEM

A. Provide for each ladder where unbroken height between levels exceeds 24 feet, or at lesser height where indicated on Drawings.

B. Install in accordance with manufacturer’s instructions.

C. Furnish additional accessories required to complete system for each ladder.

D. Furnish one harness for each ladder equipped with safety climb device.

E. Furnish pivot section at platforms, landings, and roofs.

F. When installed to required height, fall prevention system shall be rigid and an integral part of the structure.

3.05 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer’s written instructions.

B. Titanium: Where titanium equipment is in contact with concrete or dissimilar metal, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70-durometer hardness.

C. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.06 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

C. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

3.07 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer’s Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements and Section 01 88 15, Anchorage and Bracing.

3.08 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	**Product**	**Remarks**
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating

Service Use and Location	Product	Remarks
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Hot-dip galvanized steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Anchors Cast in Grout-Filled Concrete Masonry Units		
Dry Areas	Hot-dip galvanized steel headed anchor bolts or zinc-plated steel sleeve anchors	
Exterior and Interior Wet Areas	Hot-dip galvanized steel headed anchor bolts, zinc-plated or stainless steel sleeve anchors	
5. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
6. Connections for Steel Fabrications and Wood Components		
Exterior and Interior Wet and Dry Areas	Hot-dip galvanized carbon steel bolted connections	

Service Use and Location	Product	Remarks
7. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
8. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

SECTION 05 52 16
ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
3. American Iron and Steel Institute (AISI).
4. ASTM International (ASTM):
    a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
    b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
    c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
    d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
    e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
5. International Code Council (ICC): International Building Code (IBC).
6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC IBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.

1. Top Rail: Capable of withstanding the following load cases applied:
   a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICC IBC and OSHA.
   b. Uniform load of 50 pounds per linear foot applied in any direction in accordance with ICC IBC.
   c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC IBC.
2. Mid-Rail: Capable of withstanding the following load cases applied: Concentrated load of 150 pounds applied at any point and in any direction in accordance with OSHA.
3. Toeboard: Capable of withstanding, without failure, a force of at least 50 pounds applied in any downward or outward direction at any point along the toeboard.
4. Calculated lateral deflection at top of posts shall not exceed 1 inch.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer's literature and catalog data of railing and components.
   c. Design Data: Calculations or test data using specified design performance loads and including the following:
      1) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
      2) Design of post base connection.
      3) Documentation that concrete anchors have been designed in accordance with one of the following:
         a) ACI 318, Appendix D.
         b) ICC Evaluation Services Report for selected anchor.

2. Samples:
    a. Rail sections, 6 inches long showing each type of proposed connection, proposed finish, and workmanship.
    b. Each fitting including wall brackets, castings, toeboard, and rail expansion joints.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.
2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.
3. Test Reports: Test data may supplement load calculations providing data covers complete railing system, including anchorage:
    a. Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
        1) Railing and post connections.
        2) Railing wall connections.
        3) Railing expansion joint connections.
        4) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
    b. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC IBC.
    c. Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows: maximum calculated lateral deflection at top of posts shall not exceed 1 inch.
    d. Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
4. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

B. Delivery:

1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
2. Deliver toeboards loose for field assembly.
3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 304 or Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
2. Tensile Strength: 38,000 psi, minimum.
3. Yield Strength: 35,000 psi, minimum.

4. Nominal Wall Thickness: 0.145 inch, minimum.
5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).

C. Accessories:

1. Fittings and Accessories:
   a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
   b. Gauge metal components are not acceptable for load-resisting components.
   c. Fittings shall match color of pipe in railings.
2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
3. Castings for Railings:
   a. Cast Al-mag with sufficient strength to meet load and test requirements.
   b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
4. Post Anchorages:
   a. Refer to standard details for types of post anchorages and minimum requirements.
   b. Bolts at anchorages shall be minimum 1/2-inch diameter.
5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 304 or Type 316 stainless steel bolts or concrete anchors.
6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
7. Railing System Gate:
   a. Extruded aluminum rail components.
   b. Hardware Manufacturers and Products:
      1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.
      2) CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.
      3) Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.
8. Railing Picket Panels and Clamps:
   a. 1/2-inch Schedule 40 aluminum pipe (picket).
   b. Extruded aluminum 1-1/2-inch by 7/8-inch by 1/8-inch channel.
   c. Furnish neoprene plug for each end of picket.
   d. Fasteners: Stainless steel.

9. Toeboards:
    a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
    b. Provide slotted holes for expansion and contraction where required.

D. Finishes:

1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 304 or Type 316 stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 304 or Type 316 stainless steel.

C. Concrete Anchors:

1. Stainless steel, AISI Type 304 or Type 316.
2. Post-installed anchors in accordance with Section 05 05 19, Post-installed Anchors, unless otherwise specified herein.
3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 6-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
    a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
    b. Field fit-up is required.
3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

A. Field fabrication of aluminum railing systems is not permitted.

B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.

F. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.

E. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.

3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.
5. Toeboards shall be attached to posts via clamp that complies with design requirements while facilitating expansion and contraction. Do not screw directly to post or its base.

F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Owner-Furnished Quality Assurance, in accordance with ICC IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.05 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   d. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. MBG 531, Metal Bar Grating Manual.
   b. MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
   c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
   d. Manufacturer's specifications, including coatings, surface treatment, and finishes.

B. Informational Submittals:

1. Special handling and storage requirements.
2. Installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Insofar as is practical, factory assemble items.

B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
2. HARSCO Industrial IKG, Houston, TX.
3. Ohio Gratings, Inc., Canton, OH.

2.02 GRATING MATERIALS

A. Carbon Steel:

1. Bearing Bars, Banding, and Rectangular Cross Bars: ASTM A1011/A1011M commercial steel Type II for hot rolled carbon steel sheet and strip, or ASTM A36/A36M.
2. Cross Bars made from Wire Rods: Not permitted.
3. Finish: Galvanized after fabrication.

2.03 METAL BAR GRATING

A. General Requirements:

1. Maximum Service Load:
   a. Light Duty (Type A): 100 psf uniformly distributed load.
   b. Medium Duty (Type B): 500 psf uniformly distributed load.
2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
3. Bearing Bar Spacing:
   a. Light Duty: 1-3/16 inch maximum, center-to-center.
   b. Medium Duty: 15/16 inch maximum, center-to-center.
4. Cross Bar Spacing: 4 inches maximum, center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.

B. Grating Materials: Galvanized steel welded, rectangular bar grating fabricated by electro-forging cross bars to bearing bars.

C. Surface:

1. Plain or Serrated as noted on Drawings, unless otherwise specified on Drawings.
2. When surface of bars is serrated provide 1/4-inch deeper bearing bars than shown on Drawings to maintain specified load carrying capacity of grating.

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.04 HEAVY-DUTY METAL BAR GRATING (TYPE C)

A. General Requirements:

1. Maximum Service Load: AASHTO H-20.
2. Maximum Deflection: Span/240.
3. Bearing Bar Spacing: 1-7/8 inch maximum center-to-center.
4. Cross Bar Spacing: 4 inches maximum center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 532 or as shown on Drawings.
6. Grating Type: Galvanized steel, heavy-duty, rectangular bar grating fabricated by welding crossbars between rectangular bearing bars.

2.05 ACCESSORIES

A. Embedded Frames: As indicated on Drawings and as specified in Section 05 50 00, Metal Fabrications.

B. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
   a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
   b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

C. Anchor Stud and Saddle Clip:

1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
2. Removable from above grating walkway surface.
3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
4. Manufacturers and Products:
   a. Welded Stud Anchor:
      1) Nelson Stud Welding, Inc., Elyria, OH.
      2) Stud Welding Associates, Inc. Elyria, OH.
   b. Saddle Clip:
      1) Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
      2) Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
      3) Struct-Fast, Inc., Baltimore, MD; Gratefast.

2.06 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531 or NAAMM MBG 532.
2. Do not weld aluminum grating.
3. Conceal fastenings where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Cutouts:
   a. Fabricate in grating sections for penetrations indicated.
   b. Arrange to permit grating removal without disturbing items penetrating grating.
   c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
6. Do not notch bearing bars at supports to maintain elevation.
7. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
8. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
9. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.
10. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531 and NAAMM MBG 532.

B. Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.

C. Heavy Duty Metal Bar Grating: Minimum width of grating sections shall be 2 feet regardless of length and weight.

D. Supports:

1. Same material as grating, except that supports which are to be embedded in concrete shall be Type 316 stainless steel, unless part of an extruded aluminum system.
2. Coordinate dimensions and fabrication with grating to be supported.
3. Coordinate dimensions with increased depth due to serrations.

PART 3 EXECUTION

3.01 PREPARATION

A. Electrolytic Protection:

1. Protect aluminum surfaces in contact with dissimilar metals, or embedded or in contact with masonry, grout, or concrete as specified in Section 09 90 00, Painting and Coating.
2. Allow paint to dry before installation of material.

3.02 INSTALLATION

A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.

B. Install manufactured products in accordance with manufacturer's recommendations.

C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.

D. Install grating supports plumb and level as applicable.

E. Install sections of welded frames with anchors to straight plane without offsets.

F. Field locate and install fasteners to fit grating layout.

G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

H. Each grating or plank section shall be easily removable and replaceable.

I. Completed installation shall be rigid and neat in appearance.

J. Protect painted and galvanized surfaces during installation.

K. Repair damaged coatings as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
7. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
   l. SP 13, Surface Preparation of Concrete.
   m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PDS: Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Product Data Sheet (PDS), the manufacturer’s technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Technical and performance information that demonstrates compliance with specification.
      4) Furnish copies of paint system submittals to the coating applicator.
      5) Indiscriminate submittal of only manufacturer’s literature is not acceptable.
   b. Detailed chemical and gradation analysis for each proposed abrasive material.

2. Samples:
    a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
    b. Reference Panel:
        1) Surface Preparation:
            a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
            b) Provide panel representative of the steel used; prevent deterioration of surface quality.
            c) Panel to be reference source for inspection upon approval by Engineer.
        2) Paint:
            a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
            b) Furnish additional samples as required until colors, finishes, and textures are approved.
            c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. Coating for Faying Surfaces: Manufacturer's test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.
6. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
7. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perf orm surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC PA 10.
   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

B. Status of Existing Coatings: The following information on existing coatings or substrate conditions is provided for information only, and is generally believed to be accurate, but is not guaranteed. Perform tests as required to verify applicability of this information to the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of 5 years' verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Tnemec.
2. Sherwin Williams.
3. Carboline.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required
Acrylic Latex (Flat)	Flat latex
Acrylic Sealer	Clear acrylic
Alkyd (Semigloss)	Semigloss alkyd
Alkyd Enamel	Optimum quality, gloss or semigloss finish as required, medium long oil
Alkyd Wood Primer	Flat alkyd
Bituminous Paint	Single-component, coal-tar pitch based
Block Filler	Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service
DTM Acrylic Primer	Surface tolerant, direct-to-metal water borne acrylic primer
DTM Acrylic Finish	Surface tolerant, direct-to-metal water borne acrylic finish coat
Elastomeric Polyurethane	100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service

Product	Definition
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
Epoxy Primer—Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service
TFE Lube or Grease Lube	Tetrafluoroethylene, liquid coating, or open gear grease as supplied by McMaster-Carr Supply Corporation, Elmhurst, IL
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Epoxy, High Solids	Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

Product	Definition
Organic Zinc Rich Primer	Epoxy or moisture cured urethane with 85-percent zinc content in the dry film, meeting the requirements of RCSC Specification for Structural Joints using High Strength Bolts, Class A or Class B, as required.
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading
Sanding Sealer	Co-polymer oil, clear, dull luster
Silicone/Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based
Stain, Concrete	Acrylic, water repellant, penetrating stain
Stain, Wood	Satin luster, linseed oil, solid or transparent as required
Varnish	Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, urethane) in gloss, semigloss, or flat finishes, as required
Water Base Epoxy	Two-component, polyamide epoxy emulsion, finish as required

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Ductile Iron Pipe:
   a. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.
   b. The surface preparation and application of the primer shall be performed by pipe manufacturer.
   c. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.
   d. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.
2. Steel Pipe:
   a. Surface preparation and application of primer shall be performed by pipe manufacturer.
   b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently dried.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every500 square feet by means of a Chlor Test CSN Salts or approved equivalent.
2. Surface with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/square centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
3. Follow manufacturer's recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
   a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
   b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
   c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
   d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP-16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).

2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.

4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.

5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
    a. Prepare such that there is:
        1) No undercutting or reverse ridges on weld bead.
        2) No weld spatter on or adjacent to weld or any area to be painted.
        3) No sharp peaks or ridges along weld bead.
    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.
    e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

D. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
2. Brush blast in accordance with SSPC SP 16.
3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

E. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.
2. Meet requirements of SSPC SP 13.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.
5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

F. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

G. Masonry Surface Preparation:

1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.
2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
    a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
    b. Brush-off blasting.
    c. Water blasting.

4. Do not damage masonry mortar joints or adjacent surfaces.
5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair intended finished appearance.
7. Masonry Surfaces to be Clear Coated: Free of discolorations and uniform in texture after cleaning.

H. Wood Surface Preparation:

1. Replace damaged wood surfaces or repair in a manner acceptable to Engineer prior to start of surface preparation.
2. Solvent clean (mineral spirits) knots and other resinous areas and coat with shellac or other knot sealer, prior to painting. Remove pitch by scraping and wipe clean with mineral spirits or turpentine prior to applying knot sealer.
3. Round sharp edges by light sanding prior to priming.
4. Filler:
    a. Synthetic-based wood putty approved by paint manufacturer for paint system.
    b. For natural finishes, color of wood putty shall match color of finished wood.
    c. Fill holes, cracks, and other surface irregularities flush with surrounding surface and sand smooth.
    d. Apply putty before or after prime coat, depending on compatibility and putty manufacturer's recommendations.
    e. Use cellulose type putty for stained wood surfaces.
5. Ensure surfaces are clean and dry prior to painting.

I. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.

1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

J. Existing Painted Surfaces to be Repainted Surface Preparation:

1. Detergent wash and freshwater rinse.
2. Clean loose, abraded, or damaged coatings to substrate by hand or power tool, SP 2 or SP 3.
3. Feather surrounding intact coating.
4. Apply one spot coat of specified primer to bare areas, overlapping prepared existing coating.
5. Apply one full finish coat of specified primer to entire surface.

6. If an aged, plural-component material is to be topcoated, contact coating manufacturer for additional surface preparation requirements.
7. Application of Cosmetic Coat:
    a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.
    b. Check compatibility by application to a small area prior to starting painting.
    c. If lifting or other problems occur, request disposition from Engineer.
8. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of SSPC.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
    a. Rate: Approximately 2 gallons per 100 square feet.
    b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
    c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
    d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.

e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.

3. Ensure surface is completely dry before application of coating.
4. Apply acid etching to obtain a "grit sandpaper" surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for existing and new, interior and exterior concrete, and metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Sand wood lightly between coats to achieve required finish.
6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.

10. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
11. Keep paint materials sealed when not in use.
12. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
2. Prepare surface and apply primer in accordance with System No. 10 specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
    a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.

D. Film Thickness and Coverage:

1. Number of Coats:
    a. Minimum required without regard to coating thickness.
    b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
    a. Do not exceed coating manufacturer's recommendations.
    b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
    a. Perform with properly calibrated instruments.
    b. Recoat and repair as necessary for compliance with specification.
    c. Coats are subject to inspection by Engineer and coating manufacturer's representative.

4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 2 Submerged Metal—Domestic Sewage:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	Prime in accordance with manufacturer's recommendations	
	Coal-Tar Epoxy -OR- High Build Epoxy	2 coats, 16 MDFT 2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Metal surfaces new and existing below a plane 1 foot above maximum liquid surface, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, and the following specific surfaces:
      1) Interior surfaces of steel piping noted in the Piping Schedule.

C. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, new and existing located inside or outside of structures and exposed to weather.

D. System No. 5 Exposed Metal—Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, new and existing located inside or outside of structures and exposed to weather or in a highly humid atmosphere, such as pipe galleries and similar areas.

E. System No. 6 Exposed Metal—Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

1. Use on the following items or areas:
   a. Exposed metal surfaces, new and existing located inside or outside of structures or exposed to weather, including metal doors and frames, vents, louvers, exterior metal ductwork, flashing, sheet metalwork and miscellaneous architectural metal trim.
   b. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

F. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Coal-Tar Epoxy Tnemec 46H-413 Tnemec-Tar or equal	Strip Coat: 1 coat, 8 MDFT
	Coal-Tar Epoxy Tnemec 46H-413 Tnemec-Tar or equal	2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Use on concrete encased ferrous metals including wall pipes, pipe sleeves, access manholes, gate guides, and thimbles; and as noted on the Piping Schedule.

G. System No. 10 Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Epoxy Primer—Other	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
   a. Galvanized surfaces requiring painting.
   b. After application of System No. 10, apply finish coats as required for exposure.

3.08 COLORS

A. Provide as shown in Section 09 06 00, Schedules for Finishes designated herein for equipment and appurtenances and shown in Piping Schedule.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

2. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
   b. Fire Protection Equipment and Apparatus: OSHA Red.
   c. Radiation Hazards: OSHA Purple.
   d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code nonsubmerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
2. Pipe Color Coding: As shown in table below.
3. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.
4. Pipe Supports: Painted light gray, as approved by Engineer.

E. Pipe System Color Code:

Pipe System	**Color**
Drains and Sludge	Light Brown
Decant	Light Brown
Drains	Black
Effluent, Plant	Silver/Gray
Effluent, Secondary	Silver/Gray
Plant Service Water -W3	Medium Blue
Raw Sewage	Dark Gray
Secondary Scum	Light Brown
Sample	Medium Green
Seal Water	Federal Safety Blue

3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
   b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
   c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
   d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer's product.
4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.12 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this specification:

1. Paint System Data Sheet (PSDS)
2. Product Data Sheet (PDS).

END OF SECTION

PAINT SYSTEM DATA SHEET

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	**Product Name/Number (Proprietary)**	**Min. Coats, Coverage**

PAINT PRODUCT DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning:_____

Ambient Temperature Limitations: min. :____ max.:_____

Surface Temperature Limitations: min.:_____ max.:_____

Surface Profile Requirements: min.:_____ max.:_____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

SECTION 22 10 01
PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA):
   a. B109.1, Diaphragm Type Gas Displacement Meters (under 500 Cubic Feet Per Hour Capacity).
   b. B109.2, Diaphragm Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Over).
2. American National Standards Institute (ANSI).
3. American Public Works Association (APWA): Uniform Color Code.
4. American Society of Sanitary Engineering (ASSE):
   a. 1010, Performance Requirements for Water Hammer Arresters.
   b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
   c. 1070, Performance Requirements for Water Temperature Limiting Devices.
5. ASTM International (ASTM):
   a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
   d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
   e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
   g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
   h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   j. A197/A197M, Standard Specification for Cupola Malleable Iron.

k. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
m. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
n. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
o. A536, Standard Specification for Ductile Iron Castings.
p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
q. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
r. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
s. B32, Standard Specification for Solder Metal.
t. B61, Standard Specification for Steam or Valve Bronze Castings.
u. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
v. B75/B75M, Standard Specification for Seamless Copper Tube.
w. B88, Standard Specification for Seamless Copper Water Tube.
x. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
y. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
z. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
aa. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
bb. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
cc. B306, Standard Specification for Copper Drainage Tube (DWV).
dd. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
ee. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
ff. C1460, Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground.
gg. C1540, Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
hh. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

ii. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
jj. D2000, Standard Classification System for Rubber Products in Automotive Applications.
kk. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
ll. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
mm. D2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
nn. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
oo. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
pp. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
qq. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
rr. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
ss. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
tt. E438, Standard Specification for Glasses in Laboratory Apparatus.
uu. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
vv. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
ww. F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
xx. F1924, Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing.
yy. F1973, Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems.

6. American Water Works Association (AWWA):
    a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
    b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
    c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    e. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast.
    f. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied.
    g. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
    h. C606, Grooved and Shouldered Joints.
    i. C651, Disinfecting Water Mains.
7. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
8. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arresters Standard.

1.02 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following: Local plumbing code.

1.03 SUBMITTALS

A. Action Submittals:

1. Product data sheets.
2. Shop Drawings:
    a. Show Contractor recommended changes in location of fixtures or equipment.
    b. Anchorage and bracing drawings and data sheets, as required by Section 01 88 15, Anchorage and Bracing.
3. Isometric riser diagrams showing locations of supports, hangers, valves, equipment and elevations.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the work.
3. Complete list of products proposed for installation.
4. Test records produced during testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

B. Natural gas piping installed within buildings and up to 5 feet beyond exterior walls shall meet 2012 International Fire Code.

2.02 PIPING

A. Piping Schedule: Refer to Section 40 27 00, Process Piping—General and see Drawings, Plumbing legend.

B. Piping Material: Refer to Piping Data Sheet(s), Article Supplements and Section 40 27 00, Process Piping—General.

2.03 HOSE VALVES AND HYDRANTS

A. YH-1, Yard Hydrant:

1. Nonfreeze, bronze casing, 3/4-inch to 2-inch inlet and outlet, for 3 foot of bury.
2. Size as indicated on Drawings.
3. Manufacturers and Products:
   a. J. R. Smith; Figure 5910 Series.
   b. Wade, Division of Tyler Pipe; 8610 Series.
   c. Zurn; 1385 (3/4 inch to 1 inch) and 1390 (1-1/4 inch to 2 inch).

B. HV-1, Hose Valve:

1. Cast bronze globe valve, 3/4-inch size, with NPT screwed ends, union bonnet, rising stem, Teflon disc, hand wheel, and NPT by NST hose thread adapter outlet connection.
2. Rated 150-pound service water pressure, 300-pound WOG.
3. Manufacturers and Products:
   a. Nibco; Catalog No. T-235-Y, Angle No. T-335-Y.
   b. Crane Co.; Catalog No. 7TF, Angle No. 17TF.

2.04 PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

2.05 INSULATION

A. As specified in Section 40 42 13, Process Piping Insulation.

2.06 VALVES

A. Refer to Section 40 27 02, Process Valves and Operators.

B. Water Pressure Reducing Valves 1/2 Inch Through 2-1/2 Inches (PRV-1):

1. Direct diaphragm operated, spring controlled, bronze body, NPT threaded ends, 200-psig rated minimum.
2. Size/Rating: Inlet pressure: 110 psi, outlet pressure 70 psi.
3. Manufacturers and Products:
   a. Fisher; Type 75A.
   b. Watts; Series 223.

C. Pressure Reducing Valve, Natural Gas and Propane, 2 psi to 11-Inch WC:

1. Direct diaphragm, spring controlled cast-iron body, spring aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT thread ends, 125-psig rated.
2. Size/Rating: Size per Drawings, inlet pressure of 2 psig, outlet pressure set at 11-inch water column or as required by equipment connection.
3. Manufacturer and Product: Fisher; S201.

D. Gauge Cock Valves 1/8 Inch to 3/8 Inch:

1. Bronze body, hexagon male and female ends, and tee head.
2. Rated for 125-pound SWP.
3. Manufacturers and Product:
   a. Ernst Gage Co.
   b. Lunkenheimer.

E. Manual Air Vent Valves:

1. With coin-operated air vent.
2. Manufacturers and Products:
   a. Bell & Gossett; No. 4V.
   b. Dole; No. 9.

2.07 MISCELLANEOUS PIPING SPECIALTIES

A. Strainers for Water Service:

1. Iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
2. Screen: Heavy-gauge stainless steel or monel, 30 mesh.
3. Manufacturers and Products:
   a. Crane; No. 988-1/2.
   b. Mueller; No. 758.

B. Flexible Connectors for Stainless Steel Gas Lines:

1. Corrugated, Type 316 stainless steel hose, with 10-inch live length and Type 316 stainless steel male NPT pipe connectors at each end.
2. Manufacturers and Product:
   a. Flexonics; Braided Rex-Weld.
   b. Kin-Line.

C. Vacuum Breakers 2 Inches and Smaller:

1. Angle type, as required.
2. Manufacturers:
   a. Febco.
   b. Watts.

D. Water Hammer Arresters:

1. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
2. Manufacturers and Products:
   a. Sioux Chief Mfg. Co., Inc.; Series 650 and 660.
   b. Precision Plumbing Products, Inc.

E. Sleeves:

1. Manufacturers and Products:
   a. J. R. Smith; Figure 1720.
   b. Josam; No. 26400.

F. Insulating Dielectric Unions and Flanges:

1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
2. Unions 2 Inches and Smaller: Screwed or solder-joint type.
3. Unions 2-1/2 Inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
4. Manufacturers:
   a. Epco Sales, Inc., Cleveland, OH.
   b. Capitol Insulation Unions.

G. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Lead free, NSF certified. Do not use cored solder.

H. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.

I. Rubber Gaskets: ASTM C564.

2.08 MEASURING DEVICES

A. Thermometers:

1. Adjustable angle, organic spirit type, blue in color, with 9-inch case and scale range in degrees F, as shown.
2. Furnish with 3-1/2-inch stem length and separable NPT brass thermowell.
3. Manufacturers and Product:
   a. Trerice Co.; Model A005.
   b. Weksler.

B. Pressure Gauges:

1. Construction: 3-1/2-inch gauge size, 0 kPa to 690 kPa, 0 psi to 160 psi range, steel case, glass crystal, brass movement, and 1/4-inch NPT lower connection.
2. Furnish with 1/4-inch brass gauge cock.
3. Manufacturers and Products:
   a. Ashcroft; Type 1008.
   b. Marsh; J80.
   c. Marshalltown.

PART 3 EXECUTION

3.01 GENERAL

A. Install plumbing systems to meet applicable plumbing code.

B. Field Obstructions:

1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
2. Do not modify structural components, unless approved by Engineer.

C. Sleeves:

1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
4. Dry pack sleeves in existing work in-place and provide finished appearance.
5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.

D. Provide unions in piping systems at connections to equipment.

E. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.

F. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.

G. Provide isolation valves and strainers at pressure regulators.

H. Trench Excavation and Backfill: As specified in Section 31 23 16, Excavation and Section 31 23 23.15, Trench Backfill.

3.02 INSTALLATION

A. Steel Pipe:

1. Ream, clean, and remove burrs and mill scale from piping before making up.
2. Seal joints with pipe joint sealer or Teflon tape.

B. Copper Tubing:

1. Cut tubing square and remove burrs.
2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
3. Prevent annealing of fittings and hard-drawn tubing when making connections.
4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.

C. Rigid PVC or CPVC:

1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.
2. Ream, clean, and remove burrs from cut ends before joining pipe.
3. Lay in trench by snaking pipe from one side to other.
4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
6. Shield ends to be joined from direct sunlight prior to and during laying operation.
7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.

D. Water System Balancing: Provide a qualified registered engineer or firm specializing in testing and balancing to adjust domestic water system. Balance system for required water flows at each plumbing fixture, terminal device, and recirculating hot water loop.

E. Water Hammer Arresters:

1. Install in piping systems where shown on Drawings and adjacent to pieces of equipment where quick closing valves are installed.
2. Install at all emergency safety showers and eyewashes.
3. Size and install in accordance with PDI-WH201.
4. Shock arresters to have access panels or to be otherwise accessible.

F. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.

G. Measuring Devices: Install in accordance with manufacturer's recommendations.

H. Line and Appliance Pressure Regulators: Install line pressure regulators and appliance regulators in accordance with the manufacturer's requirements and in accordance with International Fire Code. Install each regulator in an accessible location and install shutoff valves ahead of each line and appliance regulator to allow for maintenance. Where vent limiting devices are not included in the regulators, install a vent pipe to the exterior of the building. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.03 WATER SUPPLY PIPING

A. Water supply piping includes Potable (W1) and Non potable water (W2).

B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer’s recommended flow.

C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.

D. Provide exterior water piping with minimum 3 feet of cover or install below frost line, whichever is greater.

E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer’s recommended gravel fill around drain hole of post hydrants.

F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.

G. Provide bypass with globe valve for emergency throttling around each reducing valve.

H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.

I. Vacuum Breakers 2 Inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.

J. Provide manual air vents at high points in domestic hot water system.

3.04 NATURAL GAS PIPING

A. Install in compliance with applicable local gas code.

B. If gas is wet, slope piping 1/4 inch per foot downward in direction of flow. Provide drip traps at low spots.

C. Install drip traps at end of runs and where pipe changes elevation.

D. Provide dirt leg, ground union joint, and isolation valve adjacent to each flexible connector hose at each appliance connection.

E. Label "NATURAL GAS, X PSIG", or "PROPANE, X PSIG" at intervals not to exceed 5 feet, indicating fuel type and pressure.

3.05 INSULATION

A. As specified in Section 40 42 13, Process Piping Insulation.

3.06 HANGERS AND SUPPORTS

A. In accordance with Section 40 05 15, Piping Support Systems.

B. Install pre-engineered support equipment in accordance with manufacturer's recommendations.

C. Hanger Rod Sizing and Spacing for:

1. Steel Pipe:

Pipe Size	Max. Hanger Spacing (feet)	Min. Rod Size (inches)
1 inch and smaller	6	1/4
1-1/4 through 2-1/2 inches	8	1/4
3 and 4 inches	10	3/8
6 inches	12	3/8
8 inches	12	1/2

2. Copper Pipe:
   a. Rod Size: Same as for steel pipe.
   b. Spacing: 2 feet less per size than for steel pipe, except pipe 1-1/4 inches and smaller shall be supported every 6 feet.

3. Plastic Pipe:
    a. Rod Size: Same as for steel pipe.
    b. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
    c. No metal portion of hanger shall contact pipe directly.

D. Attach Support Rods for Horizontal Piping:

1. To steel beams with I-clamps.
2. To concrete with inserts or with flanges fastened with flush shells.
3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.

E. Trapeze Hangers:

1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
2. Attach lines to horizontal with U-bolts or one-hole clamps.

F. Vertical Piping:

1. Support by channel type support system and pipe clamps on 10-foot maximum centers.
2. Copper and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.

G. Insulated Piping: Furnish galvanized protection shield and oversized hangers under insulated piping.

3.07 INSTALLATION—CONCRETE ENCASED

A. Where horizontal piping is encased in concrete such as a floor or equipment slab, rigidly mount pipe to rebar and subbase to prevent lateral movement, sagging, and uplifting during concrete installation and finishing. Provide at least two temporary strut supports wired to rebar and supported from the engineered fill or subbase below for each section of pipe.

B. Where construction joints occur, or piping leaves concrete encasements at buildings, utility trenches, vaults, slabs and other structures, provide elastomeric foam insulation wrap around the pipe at the transition point.

1. Minimum Wrap: five pipe diameters of 1/2-inch-thick insulation on each side of the transition.

C. Provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.08 INTERIM CLEANING

A. As specified in Section 40 27 00, Process Piping—General.

B. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.

C. Examine piping to assure removal of foreign objects prior to assembly.

D. Conventional commercial cleaning methods of cleaning are acceptable if method and cleaning material does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.09 TESTING

A. General:

1. Conduct pressure and leakage tests on newly installed pipelines.
2. Provide necessary equipment and material, and make taps in pipe, as required.
3. Test Pressures: As specified herein and in Piping Schedule.
4. Test Records: Make records of each piping system installation during test to document the following:
    a. Date of test.
    b. Description and identification of piping tested.
    c. Test fluid.
    d. Test pressure.
    e. Remarks, including:
        1) Leaks (type, location).
        2) Repairs made on leaks.
    f. Certification by Contractor and signed acknowledgment by Engineer that tests have been satisfactorily completed.

B. Testing New Pipe Connected to Existing Pipe: Isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.

C. Preparation and Execution:

1. Buried Pressure Piping:
    a. An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by Engineer.

b. Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.
c. Conduct final hydrostatic acceptance tests after trench has been completely backfilled.

2. Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

D. Hydrostatic Leak Tests:

1. Equipment: Provide the following:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

2. Procedure:
   a. Use water as the hydrostatic test fluid.
   b. Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.
   c. Open vents at high points of the piping system to purge air pockets while the piping system is filling.
   d. Venting during filling of system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.
   e. Test piping systems at test pressure specified in Piping Schedule.
   f. Maintain hydrostatic test pressure continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage.
   g. Examine joints and connections for leakage.
   h. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.
   i. Correct visible leakage and retest to satisfaction of Engineer.
3. Buried Water Lines:
   a. A limited amount of leakage is permissible according to formula specified.
   b. Conduct hydrostatic testing as follows:
      1) Pipe with Concrete Thrust Blocking: Do not make pressure test until a minimum of 5 days after thrust blocking is installed.
      2) If high-early strength cement is used for thrust blocking, time may be reduced to 2 days.

c. Cement-Lined Piping: Slowly fill test section with water and allow to stand for 24 hours under slight pressure to allow cement lining to absorb water.
d. Expel air from piping system prior to testing.
e. Apply and maintain specified test pressure with hydraulic force pump.
f. Valve off the piping system when test pressure is reached.
g. Conduct pressure test for 2 hours, reopening isolation valve only as necessary to restore test pressure.
h. Accurately measure amount of water required to maintain test pressure by placing pump suction in a barrel or similar device, or by metering.
i. The measurement represents leakage, defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period.
j. Determine maximum allowable leakage in gallons per hour from the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

L = Allowable leakage, in gallons per hour
N = Number of joints in the length of pipe tested
D = Nominal diameter of pipe, in inches
P = Test pressure during the leakage test, in pounds per square inch

k. Correct leakage greater than the allowable determined under this formula, and retest to satisfaction of Engineer.

4. Test Pressure for Water: 1-1/2 times system pressure.
5. Gravity Sewers and Drains:
   a. Test by water or air exfiltration tests as prescribed by local or state plumbing codes and visually examine for leaks.
   b. Repair leaks and retest system until no further leakage is evident.

E. Pneumatic Leak Tests:

1. Perform on natural gas piping.
2. Equipment: Provide the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure
1	Calibrated test gauge

3. Procedure:
   a. Perform pneumatic testing using accurately calibrated instruments and oil-free, dry air.
   b. Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.
   c. Test piping system at test pressure specified in Piping Schedule.
   d. Protect test personnel and Owner's operating personnel from hazards associated with air testing.
   e. Secure piping to be tested to prevent damage to adjacent piping and equipment in event of a joint failure.
   f. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.
   g. Apply maximum 25 psig preliminary pneumatic test to piping system prior to final leak testing, to locate major leaks.
   h. Examine joints and connections for leakage with soap bubbles.
   i. Correct visible leaks and retest.
   j. Gradually increase pressure in system to not more than one-half of test pressure.
   k. Thereafter increase pressure in steps of approximately 1/10 of maximum test pressure until required test pressure is reached.
   l. Maintain pneumatic test pressure continuously for minimum 10 minutes and for such additional time as necessary to conduct a soap bubble examination for leakage.
   m. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage.
   n. Correct visible leakage and retest to satisfaction of Engineer.
   o. Following pneumatic testing, thoroughly purge lines that are to carry flammable gases with nitrogen to assure no explosive mixtures will be present in system during filling process.

3.10 CORROSION PROTECTION

A. As specified in Section 40 27 00, Process Piping—General.

3.11 BONDING

A. Buried Piping: As specified.

3.12 CATHODIC PROTECTION

A. Buried Piping: As specified.

3.13 PROTECTION OF INSTALLED WORK

A. Protective Covers:

1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
3. Remove at time of Substantial Completion.

3.14 FIELD FINISHING

A. In accordance with Section 40 27 00, Processing Piping—General.

3.15 PIPING IDENTIFICATION

A. Refer to Section 40 27 00, Process Piping—General, and Pipe Schedule.

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to all sections in Division 26, Electrical and Division 28, Electronic Safety and Security. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): 1584, Guide for Performing Arc-Flash Calculations.
2. National Electrical Contractors Association (NECA).
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Electrical Safety Requirements for Employee Workplaces.

1.03 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers’ data for the following:
   a. Electrical components.
   b. Telephone components.
   c. Nameplates, signs, and labels.
   d. Fire detection and alarm components.
   e. Lightning protection components.

B. Quality Control Submittals:

1. Voltage field test results.
2. Voltage balance report.
3. Equipment line current report.
4. Factory test certification and reports for all major electrical equipment.
5. Site test certification and reports as specified in other Division 26, Electrical, and Division 28, Electronic Safety and Security sections.

1.04 DESIGN REQUIREMENTS

A. All equipment anchoring and mounting shall be in accordance with manufacturer’s requirements for the seismic zone criteria given in Section 01 61 00, Common Product Requirements.

B. Provide lightning protection system design and installation per Section 26 41 00, Facility Lightning Protection.

C. Provide comprehensive short circuit and protective device coordination studies per Section 25 05 70, Electrical Systems Analysis. Initial complete short circuit study shall be submitted, reviewed, and approved before major electrical equipment Shop Drawings will be reviewed.

D. Provide arc flash study per Section 26 05 70, Electrical Systems Analysis. Maximum acceptable Arc Flash Hazard Category will be 2. Each trip unit on the low voltage switchgear main and feeder breakers will be provided with an arc flash reduction maintenance switch.

1.05 SCOPE OF WORK

A. Furnish, install, and test low voltage Site power distribution system as shown.

B. Furnish and install the low voltage and control duct bank systems as shown.

C. Furnish, install, and test a completely integrated grounding electrode system for the plant. The entire plant shall have a common integrated grounding electrode system.

D. Furnish, install, terminate, and test all interconnecting power, control, and instrumentation wiring as shown on the One-Line Diagrams and P&ID Drawings.

E. Furnish and install all conduit, wiring, and field connections for all motors, motor controllers, control devices, control panels, and electrical equipment furnished under other divisions of these Specifications.

F. Furnish and install equipment grounding conductors sized per Table 250-122 of the NEC unless otherwise shown on the Drawings, in all conduits throughout the entire plant.

G. Furnish, install, and wire all Site and facility lighting as shown on the Drawings.

H. Design, furnish, install, and test a complete lightning protection system as specified.

I. Conduct and participate in all electrical and PICS subcontractor's testing. Specifically all operational readiness tests and functional acceptance tests shall be jointly conducted by the PICS subcontractor and the Electrical subcontractor.

J. Provide short circuit, protective device coordination, and arc flash studies as specified.

K. Sequence Work to meet the Contractor's overall schedule and construction sequence.

L. The Work shall include complete testing of all equipment and wiring at the completion of Work and making any necessary corrections or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

M. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc). Any temporary added shall be removed at job completion.

N. Complete coordination with other Contractors. Contractor shall coordinate with all other Contractor's equipment submittals and obtain all relevant submittals.

O. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the Site, in which Work under this Division is to be performed. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the Site, and noted the locations and conditions under which the Work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

1.06 AUTHORITY HAVING JURISDICTION APPROVAL

A. As a minimum, provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority having Jurisdiction (AHJ) or the specifications, material and equipment shall be labeled or listed by a Nationally Recognized Testing Laboratory (NRTL) or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied listing mark or label by a NRTL.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.07 HAZARDOUS AND CORROSIVE AREA CLASSIFICATIONS

A. Several areas in the plant are classified as hazardous and corrosive. Equipment, materials, and installation in these areas shall comply with NEC Articles 500, 501, 502, and 503. All equipment and materials installed in hazardous areas shall be NRTL labeled for the appropriate hazardous area classifications, as shown on the Drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

D. Provide equipment panels installed outdoors in direct sun with sun shields.

E. Provide materials and equipment listed/labeled by a NRTL to UL standards where they have been established by the agency.

2.02 EQUIPMENT FINISH

A. Manufacturer’s standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with ANSI No. 61, light gray color.

2.03 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: Black, engraved to a white core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Other electrical equipment: 1/4 inch.

2.04 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

B. Warning labels for arc flash hazards shall be provided per NEC code.

C. Based on the results of arc-flash calculations performed as specified in Section 26 05 70, Electrical Systems Analysis, provide appropriate warning labels on all electrical equipment.

PART 3 EXECUTION

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer. Coordinate the conduit installation with other trades and the actual supplied equipment. Obtain information relevant to the placement of electrical work and in case of any interference with other work, processed as directed by the Engineer and furnished all labor and materials necessary to complete the Work in an approved manner.

B. Check approximate locations of light luminaires, switches, receptacles, disconnect switches, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing. Any adjustments required in the field shall be provided at no additional cost to the Owner.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

F. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Owner.

H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement or equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

I. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported with 1/2-inch spacers to provide a clearance between wall and equipment.

J. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45-degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

K. The Contractor shall coordinate with the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc, required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

L. Provide raceways and conductors as required by the fire alarm system manufacturer for a complete and operating system. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in process spaces.

M. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal system as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

N. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

O. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

3.02 ANCHORING AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer’s requirements for seismic zone criteria given in Section 01 61 00, Common Product Requirements.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.
    a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
    c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
    d. Raceways shall be sized per General Circuit and Raceway Schedule and shall not exceed 40 percent fill.

e. Changes shall be documented on Record Drawings.

2. Discrete control circuits from devices in the same general area to the same destination.
   a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
   b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
   c. Raceways shall be sized per the General Circuit and Raceway Schedule and shall not exceed 40 percent fill.
   d. Changes shall be documented on Record Drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
   a. Lighting Circuits: Combine no more than three circuits, with separate neutrals, to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits, with separate neutrals, to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs: Field mark switchboards, motor control centers, panelboards, etc. to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.

B. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying a building, and the area served by each.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, dry-type transformer, and terminal junction box nameplates shall include equipment designation.

3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

D. Procedural Signs: Provide procedural signs for Kirk-Key interlocks and main-tie-main operation sequences.

3.05 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain Shop Drawings and templates from equipment vendors or other subcontractors and locate the concealed conduits before the floor slab is poured.

C. Where setting Drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installation of such conduits to be exposed. Request for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetrations and slots as specified in Section 26 05 33, Raceway and Boxes.

3.07 CUTTING AND PATCHING

A. Cutting and patching shall be done in a thoroughly workmanlike manner and be in compliance with modifications and repair to concrete.

B. Install work at such time as to require the minimum amount of cutting and patching.

C. Do not cut joists, beams, girders, columns, or any other structural members.

D. Cut openings only large enough to allow easy installation of the conduit.

E. Patching to be of the same kind and quality of material as was removed.

F. The completed patching work shall restore the surface to its original appearance or better.

G. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

H. Remove rubble and excess patching materials from the premises.

3.08 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.09 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor’s convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer at the Engineer’s discretion.

3.10 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day.
    a. Submit Voltage Field Test Report within 5 days of test.
4. Unbalance Corrections:
    a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
    b. Obtain a written certification from a responsible power company official that the voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   c. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. Instrumentation, Systems, and Automation Society (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. AB 1, Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
   c. C12.1 Code for Electricity Metering
   d. C12.6 Phase-Shifting Devices Used in Metering, Marking and Arrangement of, Terminals for
   e. CP 1, Shunt Capacitors.
   f. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   g. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   h. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.

d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
e. 508, Standard for Industrial Control Equipment.
f. 810, Standard for Capacitors.
g. 943, Standard for Ground-Fault Circuit-Interrupters.
h. 1059, Standard for Terminal Blocks.
i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Control relays.
   c. Circuit breakers.
   d. Fused switches.
   e. Nonfused switches.
   f. Timers.
   g. Fuses.
   h. Magnetic contactors.
   i. Intrinsic safety barriers.
   j. Firestopping.
   k. Enclosures: Include enclosure data for products having enclosures.
   l. Uninterruptible Power Supply (UPS).

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied NRTL listing mark.

1.04 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Fuses, 0 to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

1. Type: Molded case.
2. Trip Ratings: 15-800 amps.
3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
4. Suitable for mounting and operating in any position.
5. NEMA AB 1 and UL 489.

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.
3. Locking provisions for padlocking breaker in open position.
4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a center position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two and three pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.
7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings:

1. Not less than the following RMS symmetrical currents for the indicated trip ratings:
   a. Less than 250V ac: 22,000 amps or as shown.
   b. 250-600V ac: 65,000 amps unless otherwise shown.
2. Series Connected Ratings: Do not apply series connected short circuit ratings.

E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).

1. Ground fault sensor shall be rated same as circuit breaker.
2. Push-to-test button.

F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).

G. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.

H. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.

I. Connections:

1. Supply (line side) at either end.
2. Mechanical wire lugs, except crimp compression lugs where shown.
3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

J. Enclosures for Independent Mounting:

1. See Article Enclosures.
2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. UL 98 listed for use and location of installation.

B. NEMA KS 1.

C. Short Circuit Rating: 200,000 amps RMS symmetrical with Class R, Class J, or Class L fuses installed.

D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

E. Connections:

1. Mechanical lugs, except crimp compression lugs where shown.
2. Lugs removable/replaceable.
3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.

F. Fuse Provisions:

1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.

G. Enclosures: See Article Enclosures.

H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

D. Enclosures: See Article Enclosures.

E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.04 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Current-limiting, with 200,000 ampere rms interrupting rating.
2. Provide to fit mountings specified with switches.
3. UL 248.

B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:

1. Class: RK-1.
2. Type: Dual element, with time delay.
3. Manufacturers and Products:
   a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
   b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).

C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Class: L.
2. Double O-rings and silver links.
3. Manufacturers and Products:
   a. Bussmann; Type KRP-C.
   b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10 amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
   a. Bussmann.
   b. Littlefuse, Inc.

2.05 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: Push-to-test.

D. Pushbutton Color:

1. ON or START: Red.
2. OFF or STOP: Black.

E. Pushbutton and selector switch lockable in OFF position.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64-inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
   a. General Electric Co.; Type CR 104P.
   b. Square D Co.; Type T.
   c. Eaton/Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D Co.; Type SK.
   b. General Electric Co.; Type CR 104P.
   c. Eaton/Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.

2.06 TERMINAL BLOCK, 600 VOLTS

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system, allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.

2.07 MAGNETIC CONTROL RELAY

A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.

B. NEMA ICS 2, Designation A600 (600 volts).

C. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable from 0.2 second to 60 seconds (minimum) unless otherwise shown.
2. Field convertible from ON delay to OFF delay and vice versa.

D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.

E. Manufacturers and Products:

1. Eaton/Cutler-Hammer; Type M-600.
2. General Electric Co.; Type CR120B.

2.08 TIME DELAY RELAY

A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.

B. NEMA ICS 2 Designation: B150 (150 volts).

C. Solid-state electronic, field convertible ON/OFF delay.

D. One normally open and one normally closed contact (minimum).

E. Repeat accuracy plus or minus 2 percent.

F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.

G. Manufacturers and Products:

1. Square D Co.; Type F.
2. Eaton/Cutler-Hammer.
3. General Electric Co.

2.09 RESET TIMER

A. Drive: Synchronous motor, solenoid-operated clutch.

B. Mounting: Semiflush panel.

C. Contacts: 10 amps, 120 volts.

D. Manufacturers and Products:

1. Eagle Signal Controls; Bulletin 125.
2. Automatic Timing and Controls; Bulletin 305.

2.10 ELAPSED TIME METER

A. Drive: Synchronous motor.

B. Range: 0 hour to 99,999.9 hours, nonreset type.

C. Mounting: Semiflush panel.

D. Manufacturers and Products:

1. General Electric Co.; Type 240, 2-1/2-inch Big Look.
2. Eagle Signal Controls; Bulletin 705.

2.11 MAGNETIC CONTACTOR

A. UL listed.

B. Electrically operated, electrically held.

C. Main Contacts:

1. Power driven in one direction with mechanical spring dropout.
2. Silver alloy with wiping action and arc quenchers.
3. Continuous-duty, rated as shown.
4. Poles: As shown.

D. Control: As shown.

E. Auxiliary Contacts: One normally open and one normally closed, rated 7200VA make, 720VA break, at 600V, A600 per NEMA ICS 5.

F. Enclosures: See Article Enclosures.

G. Manufacturers and Products:

1. Eaton/Cutler-Hammer; Class A201.
2. General Electric Co.; CR 353.
3. Square D Co.; Class 8910.

2.12 PHASE MONITOR RELAY

A. Features:

1. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.
2. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.
3. Adjustable trip and time delay settings.
4. Transient Protection: 1,000V ac.
5. Mounting: Multipin plug-in socket base.

B. Manufacturer and Product: Automatic Timing and Controls; SLD Series.

2.13 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12-gauge minimum.

C. Extruded Aluminum Framing Channel:

1. Material: Extruded from Type 6063-T6 aluminum alloy.
2. Fittings fabricated from Alloy 5052-H32.

D. Nonmetallic Framing Channel:

1. Material: Fire retardant, fiber reinforced vinyl ester resin.
2. Channel fitting of same material as channel.
3. Nuts and bolts of long glass fiber reinforced polyurethane.

E. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.14 INTRINSIC SAFETY BARRIER

A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.

B. Rating: Power source shall be rated 24 volts dc, nominal, with not more than 250 volts available under fault conditions.

C. Contact Rating: 5 amps, 250 volts ac.

D. Mounting: Rail or surface.

E. Manufacturers and Products:

1. MTL, Inc.; Series 2000 or Series 3000.
2. R. Stahl, Inc.

2.15 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire-rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by Underwriters Laboratories Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

2.16 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer’s standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the following table:

ENCLOSURES			
Location	**Finish**	**Environment**	**NEMA 250 Type**
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	12
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4X 316 Stainless Steel
Indoor and Outdoor	Any	Denoted “WP”	3R
Indoor and Outdoor	Any	Wet and Corrosive	4X 316 Stainless Steel
Indoor and Outdoor	Any	Dust or Oil	13
Indoor and Outdoor	Any	Hazardous Gas	7
Indoor and Outdoor	Any	Hazardous Dust	9

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer’s recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Unless otherwise shown, install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.

B. Unless otherwise shown, install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas.

3.03 INDUSTRIAL CAPACITORS

A. Provide suitable hangers or mounting brackets for wall or ceiling mounting.

3.04 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Channel Type:

1. Interior, Wet or Dry (Noncorrosive) Locations:
   a. Steel Raceway: Carbon steel galvanized.
2. Interior, Corrosive (Wet or Dry) Locations:
   a. PVC Conduit: Type 316 stainless steel or nonmetallic.
   b. Other Systems Not Covered: Type 316 stainless steel or nonmetallic.
3. Outdoor, Locations:
   a. Steel Raceway.
   b. Framing channel, except where mounted on aluminum handrail, then use aluminum framing channel.
   c. PVC Conduit: Type 316 stainless steel.
   d. Other Systems Not Covered: Type 316 stainless steel.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Nonmetallic Channel: Epoxy resin sealer.

3.05 INTRINSIC SAFETY BARRIERS

A. Install in compliance with ISA RP12.06.01.

B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.

C. Stencil “INTRINSICALLY SAFE CIRCUIT” on all boxes enclosing barriers.

3.06 FIRESTOPS

A. Install in strict conformance with manufacturer’s instructions. Comply with installation requirements established by testing and inspecting agency.

B. Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. B3, Standard Specification for Soft or Annealed Copper Wire.
   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   d. B263, Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors.
2. Electronic Industries Alliance (EIA), Telecommunications Industry Association (TIA): TIA-568-B, Commercial Building Telecommunications Cabling Standard.
3. Insulated Cable Engineer's Association, Inc. (ICEA):
   a. S-58-679, Standard for Control Cable Conductor Identification.
   b. S-73-532, Standard for Control Cables.
   c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 386, Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
5. National Electrical Manufacturers' Association (NEMA):
   a. CC 1, Electric Power Connectors for Substations.
   b. WC 55, Instrumentation Cables and Thermocouple Wire.
   c. WC 70, Standard for Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 262, Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
7. Underwriters Laboratories Inc. (UL):
   a. 13, Standard for Safety Power-Limited Circuit Cables.
   b. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
   c. 62, Standard for Safety Flexible Cord and Fixture Wire.
   d. 486A-486B, Wire Connectors.
   e. 486C, Standard for Splicing Wire Connections.
   f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

g. 854, Standard for Safety Service-Entrance Cables.
h. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
i. 1569, Metal Clad Cables.
j. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

1. Wire and cable descriptive product information.
2. Wire and cable accessories descriptive product information.
3. Manufactured wiring systems descriptive product information.
4. Manufactured wire systems rating information.
5. Manufactured wire systems dimensional drawings.
6. Manufactured wire systems special fittings.
7. Cable Pulling Calculations:
   a. Calculations shall be submitted and reviewed before cable installation.
   b. Provide cable pulling calculations for the following cable installations:
      1) Multi-conductor 600-volt cable sizes larger than No. 2 AWG that cannot be hand pulled.
      2) Power and control conductor, and control and instrumentation cable installations in ductbanks.
      3) Feeder circuits, single conductors No. 4/0 and larger.

B. Informational Submittals:

1. Certified Factory Test Report for conductors 600 volts and below.
2. Certified Factory Test Report per AEIC CS6, including AEIC qualification report for conductors above 600 volts.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied NRTL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer’s name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:
   a. No. 14 AWG, seven-strand copper.
   b. Insulation: 15-mil PVC with 4-mil nylon.
   c. UL 1581 listed as Type THHN/THWN rated VW-1.
   d. Conductor group bound with spiral wrap of barrier tape.
   e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
   a. Okonite Co.
   b. Southwire.

C. Type 2, Multiconductor Power Cable:

1. General:
   a. Meet or exceed UL 1581 for cable tray use.
   b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
   c. Overall jacket: PVC.
2. Conductors:
   a. Class B stranded, coated copper.
   b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
   c. UL rated VW-1 or listed Type XHHW-2.

d. Color Code:
   1) Conductors, size No. 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
   2) Conductors, size No. 6 AWG and larger, ICEA S-73-532, Method 4.

3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45 45 45
10	10	2 3 4	0.54 0.58 0.63	60 60 60
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:
   a. Okonite Co.
   b. Southwire.

D. Type 3, No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 20 AWG, seven-strand tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.
    d. Jacket: 4-mil nominal nylon.
    e. Color Code: Pair conductors, black and red.
5. Manufacturers:
    a. Okonite Co.
    b. Alpha Wire Corp.
    c. Belden.

E. Type 4, No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.32-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 20 AWG, seven-strand, tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.
    d. Jacket: 4-mil nylon.
    e. Color Code: Triad conductors black, red, and blue.
5. Manufacturers:
    a. Okonite Co.
    b. Alpha Wire Corp.
    c. Belden.

F. Type 5, No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 55 requirements.

1. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
    b. Tinned copper drain wires.

c. Pair drain wire size AWG 20, group drain wire size AWG 18.
d. Insulation: 15-mil PVC.
e. Jacket: 4-mil nylon.
f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

G. Type 6, No. 18 AWG, Multi-Twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
   b. Tinned copper drain wire size AWG 18.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nylon.
   e. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

Cable Sizes: Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.10	80
36	1.21	80
50	1.50	80

3. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

H. Type 7, Multi-Conductor Metal-Clad (UL Type MC) Power Cable:

1. Meeting requirements of UL 44 and UL 1569.
2. Conductors:
   a. Class B stranded, coated copper.
   b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
   c. Grounding Conductors: Bare, stranded copper.
3. Sheath:
   a. UL listed Type MC.
   b. Continuous welded, corrugated aluminum sheath.
   c. Suitable for use as grounding conductor.
4. Outer Jacket: PVC per UL 1569.
5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12 or 3x16	3 4	0.79 0.85	50
10 AWG	10 or 3x14	3 4	0.82 0.90	50
8 AWG	10 or 3x14	3 4	0.85 1.00	50
6 AWG	8 or 3x12	3 4	0.99 1.10	50
4 AWG	8 or 3x12	3 4	1.08 1.20	50
2 AWG	6 or 3x10	3 4	1.24 1.45	50
1 AWG	6 or 3x10	3 4	1.40 1.55	50
1/0 KCM	6 or 3x10	3 4	1.52 1.60	50
2/0 AWG	4 or 3x8	3 4	1.67 1.75	50
4/0 AWG	4 or 3x8	3 4	1.93 2.10	60
250 KCM	4 or 3x8	3 4	2.11 2.20	60
350 KCM	3 or 3x8	3 4	2.39 2.50	60
500 KCM	2 or 3x8	3 4	2.80 2.90	75

7. Manufacturers and Products:
   a. Okonite Co.; Type CLX.
   b. Southwire Type MC.
   c. General Cable, CCW Armored Power.

I. Type 8, Multi-Conductor Adjustable Frequency Drive Power Cable:

1. Conductors:
   a. Class B, stranded coated copper.

b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
c. Grounding Conductors: Insulated stranded copper.

2. Sheath:
   a. UL 1277 Type TC, 90 degrees C.
   b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.
3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12	4	0.610	50
10 AWG	10	4	0.670	50
8 AWG	8	4	0.910	50
6 AWG	6	4	1.010	50
4 AWG	4	4	1.150	50
2 AWG	2	4	1.310	50

5. Manufacturers and Products:
   a. Alpha Wire, Series V.
   b. Belden, Series 29500.
   c. LAPP USA, OLFLEX VFD Slim.

J. Type 9, Multi-Conductor Metal-Clad (UL Type MC) Power Cable for Adjustable Frequency Drive Applications:

1. Meeting requirements of UL 44 and UL 1569.
2. Conductors:
   a. Class B, stranded coated copper.
   b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
   c. Grounding Conductors: Bare, stranded copper. Provide three symmetrical grounding conductors.
3. Sheath:
   a. UL listed Type MC.
   b. Continuous welded, corrugated aluminum sheath.
   c. Suitable for use as grounding conductor.
4. Outer Jacket: PVC per UL 1569.
5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	3x16	3 4	0.79 0.85	50
10 AWG	3x14	3 4	0.82 0.90	50
8 AWG	3x14	3 4	0.85 1.00	50
6 AWG	3x12	3 4	0.99 1.10	50
4 AWG	3x12	3 4	1.08 1.20	50
2 AWG	3x10	3 4	1.24 1.45	50
1 AWG	3x10	3 4	1.40 1.55	50
1/0 KCM	3x10	3 4	1.52 1.60	50
2/0 AWG	3x8	3 4	1.67 1.75	50
4/0 AWG	3x8	3 4	1.93 2.10	60
250 KCM	3x8	3 4	2.11 2.20	60
350 KCM	3x8	3 4	2.39 2.50	60
500 KCM	3x8	3 4	2.80 2.90	75

7. Manufacturer and Product: Okonite Co.; Type CLX MC-HL.

2.03 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-B.2-1 Category 6 requirements.

2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated, comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

B. Type 31, Data Highway Cable, Allen-Bradley “Blue Hose”:

1. Meet or exceed electrical characteristics of Allen-Bradley Catalog No. 1770-CD.
2. Approved by Allen-Bradley for use with A-B programmable logic controller systems.
3. Outer Jacket: Blue PVC.
4. Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
5. Drain: 55 percent tinned copper braid and drain wire.
6. Dimension: 0.243-inch nominal OD.
7. Conductors:
   a. One pair No. 20 AWG, seven-strand tinned copper.
   b. Insulation: Polyethylene.
   c. Color Code: Blue and clear.
8. Manufacturers:
   a. Allen-Bradley.
   b. Belden.

C. Type 32, Quad Shield Coax Cable, 300 V:

1. Outer Jacket: PVDF – Fluorocopolymer.
2. Shield: Tape/Braid/Tape/Braid.
3. Dimensions: 0.274-inch, nominal OD.
4. Conductors:
   a. 18 AWG, solid bare copper –covered steel conductor.
   b. Insulation: Foam fluorinated ethylene propylene (FFEP).
   c. Type: RG/6U.
   d. Number of Coats: One.
   e. Number of Conductors: One.
   f. Impedance: 75 ohm.
5. Manufacturer and Product: Belden; 3092A.

D. Type 33, Multi Pair Snake Cable, 300 V:

1. Outer Jacket: Low smoke Polyvinyl Chloride (LSPVC).
2. Shield: Aluminum foil-polyester tape, 24 AWG tinned copper, drain wire.
3. Dimensions: 0.062-inch, nominal OD.
4. Conductors:
   a. 24 AWG, stranded, tinned copper, twisted pairs.
   b. Insulation: Foam fluorinated ethylene propylene (FFEP).
   c. Number of Pairs: Two.
5. Manufacturer and Product: Belden; 82729.

E. Type 34, RS 232 Low Capacitance Computer Cable, 300 V:

1. Outer Jacket: PVC.
2. Shield: Aluminum foil-polyester tape.
3. Dimensions: 0.455-inch, nominal OD.
4. Conductors:
   a. 22 AWG, stranded, tinned copper.
   b. Insulation: Semi-rigid PVC.
   c. Number of Pairs: 12.
5. Manufacturer and Product: Belden; 8312.

F. Type 35, RS 422 Low Capacitance Computer Cable, 300V:

1. Outer Jacket: PVC.
2. Shield: Aluminum foil-polyester tape.
3. Drain: 24 AWG, stranded, tinned copper.
4. Dimensions: 0.575-inch nominal OD.
5. Conductors:
   a. 24 AWG, stranded, tinned copper.
   b. Insulation: Foam Polyethylene.
   c. Number of Pairs: 12.
6. Manufacturer and Product: Belden; 9734.

2.04 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Tin-plated bare stranded copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
    a. 30-mil, elastomer.
    b. Manufacturers and Products:
        1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
        2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
    a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
    b. Manufacturers and Products:
        1) Raychem; Type D-SCE or ZH-SCE.
        2) Brady, Type 3PS.
2. Heat Bond Marker:
    a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
    b. Self-laminating protective shield over text.
    c. Machine printed black text.
    d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
    a. Chemical resistant white tag.
    b. Size: 1/2 inch by 2 inches.
    c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
    a. Manufacturers and Products:
        1) Thomas & Betts; Sta-Kon.
        2) Burndy; Insulug.
        3) ILSCO.

2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Seamless.
   c. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
   a. UL 486C.
   b. Plated steel, square wire springs.
   c. Manufacturers and Products:
      1) Thomas & Betts.
      2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
   a. Two piece compression type with set screw in brass barrel.
   b. Insulated by insulator cap screwed over brass barrel.
   c. Manufacturers:
      1) 3M Co.
      2) Thomas & Betts.
      3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
   a. Extended barrel, suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Manufacturers and Products:
      1) Thomas & Betts; Color-Keyed.
      2) Burndy, Hydent.
      3) ILSCO.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
   a. Manufacturers and Products:
      1) Thomas & Betts; Locktite.
      2) Burndy; Quiklug.
      3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

G. Data Cable Accessories: Terminators, connectors, and junctions necessary for a complete DeviceNet, Control Net, Foundation Field Bus, Profibus PA, Profibus DP system.

2.06 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.07 MANUFACTURED WIRING SYSTEMS

A. System Rating:

1. 20 amperes load-carrying capacity each phase with final assemblies consisting of maximum of three phase conductors.
2. Composition: Type MC cable with 90 degrees C insulation and stranded copper conductors.

B. Cable Configuration: Three, single-phase, five-wire circuit with standard color wire coding:

1. 208/120 Volt: Black, red, blue, white, green.
2. 480/277 Volt: Brown, orange, yellow, white, green.

C. Locking Mechanism: Latch/strike with voltage clearly marked on latch.

D. NFPA 262 listed for use in air handling plenums, listed to connect or disconnect under load, and manufactured in accordance with NFPA 70, Article No. 604.

2.08 WARNING TAPE

A. As specified in Section 26 05 33, Raceways and Boxes.

2.09 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
2. No. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with an identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

A. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

C. Method:

1. Conductors No. 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors No. 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG in plant of 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits exceeding 150 feet.

B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors No. 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors No. 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Tape insulate all uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape.
3. Outdoors: Use flame retardant, cold- and weather-resistant tape.

F. Cap spare conductors and conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer’s instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation and Control for Process Systems, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
   a. Under Infinite Access Floors: May install without bundling.
   b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
   c. Maintain integrity of shielding of instrumentation cables.
   d. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTOR ARC AND FIREPROOFING

A. Install arc and fireproofing tape on 600-volt single conductors and cables, except those rated Type TC throughout their entire exposed length at splices in manholes, handholes, vaults, and other indicated locations.

B. Wrap conductors of same circuit entering from separate conduit together as a single cable.

C. Follow tape manufacturer’s installation instructions.

D. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.06 UNDERGROUND DIRECT BURIAL CABLE

A. Install in trench as specified in Section 31 23 23.15, Trench Backfill.

B. Warning Tape: Install approximately 6 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

C. Refer to Standard Details.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Product data for the following:
   a. Exothermic weld connectors.
   b. Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied NRTL listing mark.

B. Main grounding electrode system resistance to ground to be no greater than 5 ohms.

PART 2 PRODUCTS

2.01 GROUND ROD

A. Material: Copper-clad.

B. Diameter: Minimum 3/4 inch.

C. Length: 20 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers:
   a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
   b. Thermoweld.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.
   c. ILSCO.

2.04 GROUNDING TRAFFIC WELLS

A. H-20 rated ground rod box complete with cast iron riser ring and H-20 traffic rated cover marked GROUND ROD.

B. Manufacturers and Products:

1. Christy Co.; No. G5.
2. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 EXECUTION

3.01 GENERAL

A. Grounding shall be in compliance with NFPA 70 and IEEE C2.

B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes. Provide dual ground to the low-voltage switchgear and motor control centers as shown on the Drawings.

C. Ground each separately derived system neutral to nearest site’s grounding electrode.

D. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

E. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

F. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

A. Grounding Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

C. Space multiple ground rods by one rod length.

3.05 GROUNDING WELLS

A. Install inside buildings, asphalt, and paved areas.

B. Install riser ring and cover flush with surface.

C. Place 12 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, or compression-type connectors.
2. Belowgrade Connections: Install exothermic weld.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer’s recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer’s recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer’s compression tool having proper sized dies.

3.07 STRUCTURE GROUNDING

A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

D. Install a ground ring around all structures and objects provided at or above finished grade as indicated on the Drawings. Ground ring shall be No. 4/0 or larger tinned bare copper conductor with ground rods at all corners (4 minimum) and at intervals not exceeding 50 feet. Provide ground test wells at a minimum of one ground rod per structure. Install 30 inches below finished grade with 2-inch, red, detectable, electrical warning tape directly above conductor and 12 inches below finished grade. Maintain 3-foot clearance to all objects and structures at or above finished grade. Cad weld ground ring and radial ground conductors to all ground rods. Cad weld radial ground cables at every ground rod to steel reinforcement members in concrete. Ground cables may exit protective conduit at these cad welds.

E. Where railings, ladders, steps, gratings, framing, process equipment, or other conductive items which are normally not energized are installed outdoors, bond to ground ring with No. 4/0 minimum tinned bare copper conductor, UL listed clamps above grade and cad welds below grade. Items such as railings which are installed as multiple sections shall be bonded together with No. 4/0 copper conductor or equivalent tinned copper strap to avoid isolation from a ground ring of any item which is required to be grounded.

F. Conductive enclosures and other exterior metal components of instruments and controls which are not normally energized shall be grounded with No. 6 minimum tinned copper conductor.

G. Ground conductors shall be protected with RGS conduit above grade. Bond ground conductors to RGS at both ends using grounding bushings.

3.08 MANHOLE AND HANDHOLE GROUNDING

A. Install one ground rod inside each.

B. Ground Rod Floor Protrusion: 4 to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with No. 6 AWG copper conductor.

3.09 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.

B. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

3.11 FIELD TESTING

A. Verify effectiveness of grounding electrode by measuring resistance to remote earth utilizing a clamp-on grounding test meter as manufactured by Greenlee or ASCO. Certificate of Calibration must be less than 12 months old. Provide test data for four different locations spread across the Site.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges, Sixteenth Edition.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Electronic Industry Alliance (EIA) and Telecommunications Industry Association (TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor’s Association, Inc. (NECA):
   a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT).
   b. 105, Recommended Practice for Installing Metal Cable Trays.
   c. 111, Standard for Installing Nonmetallic Raceway (RNC, ENT, LFNC).
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C80.1, Specification for Rigid Steel Conduit, Zinc Coated.
   c. C80.3, Specification for Electrical Metallic Tubing, Zinc Coated.
   d. TC 2, Electrical Polyvinyl Chloride (PVC) Plastic Tubing and Conduit.
   e. TC 3, Polyvinyl-Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   f. TC 6, PVC Plastic Utilities Duct for Underground Installation.

g. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
h. VE 1, Metallic Cable Tray Systems.
i. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 1, Standard for Flexible Metal Conduit.
   b. 5, Standard for Surface Metal Raceways and Fittings
   c. 6, Standard for Electrical Rigid Metal Conduit – Steel.
   d. 6A, Standard for Electrical Rigid Metal Conduit – Aluminum, Bronze, and Stainless.
   e. 50, Standard for Enclosures for Electrical Equipment.
   f. 360, Standard for Liquid-Tight Flexible Steel Conduit.
   g. 514B, Standard for Conduit, Tubing, and Cable Fittings.
   h. 514C, Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
   i. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
   j. 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
   k. 797, Standard for Electrical Metallic Tubing.
   l. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
   m. 1660, Standard for Liquid-Tight Flexible Nonmetallic Conduit.
   n. 1684, Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer’s Literature:
   a. Rigid galvanized steel conduit.
   b. Electric metallic tubing.
   c. PVC Schedule 40 conduit.
   d. PVC Schedule 80 conduit.
   e. PVC-coated rigid galvanized steel conduit, submittal to include copy of manufacturer’s warranty.
   f. Flexible metal, liquid-tight conduit.
   g. Flexible, nonmetallic, liquid-tight conduit.
   h. Flexible metal, nonliquid-tight conduit.
   i. Conduit fittings.

j. Wireways.
k. Surface metal raceway.
l. Device boxes for use in hazardous areas.
m. Junction and pull boxes used at or below grade.
n. Large junction and pull boxes.
o. Terminal junction boxes.

2. Precast Manholes and Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
3. Equipment and machinery proposed for bending metal conduit.
4. Method for bending PVC conduit less than 30 degrees.
5. Conduit Layout:
   a. Provide drawings for underground and concealed conduits including, but not limited to ductbanks, those under floor slabs, concealed in floor slabs and concealed in walls.
   b. Provide plans and section showing arrangement and location of conduit and duct bank required for:
      1) Utility primary and secondary feeders.
      2) Low voltage feeder and branch circuits.
      3) Instrumentation and control systems.
      4) Communications systems.
      5) Empty conduit for future use.
   c. Reproducible mylar; scale not greater than 1 inch equals 20 feet.

B. Informational Submittals: Manufacturer’s certification of training for PVC-coated rigid steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied NRTL listing mark.

B. PVC Coated, Rigid Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

C. PVC coated, conduit bodies, and cast metal boxes shall be provided by the PVC coated rigid steel conduit manufacturer.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. Electric Metallic Tubing (EMT):

1. Meet requirements of NEMA C80.3 and UL 797.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

C. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

D. PVC Schedule 80 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

E. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
   a. Meet requirements of NEMA C80.1 and UL 6.
   b. Exterior Finish: PVC coating, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.
   c. Interior finish: Urethane coating, 2 mils nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to either interior or exterior coating.
5. Manufacturers:
   a. Robroy, Form 8.
   b. Ocal.

F. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.

G. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 1.
2. Material: Galvanized steel.

H. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
   a. Dry Conditions: 80 degrees C insulated conductors.
   b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
   a. Carlon; Carflex or X-Flex.
   b. T & B; Xtraflex LTC or EFC.

2.02 FITTINGS

A. Rigid Galvanized Steel Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers and Products:
      1) Appleton; Series BU-I.
      2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers and Products:
      1) Appleton; Series GIB.
      2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
   a. Material: Malleable iron with insulated throat with bonding screw.
   b. UL listed for use in wet locations.
   c. Manufacturers and Products:
      1) Appleton, Series HUB-B.
      2) O-Z/Gedney; Series CH.
      3) Meyers; ST Series.
5. Conduit Bodies:
   a. Sized as required by NFPA 70.
   b. Manufacturers and Products (For Normal Conditions):
      1) Appleton; Form 35 threaded unilets.
      2) Crouse-Hinds; Form 7 or 8 threaded condulets.

3) Killark; Series O electrolets.
4) Thomas & Betts; Form 7 or 8.

c. Manufacturers (For Hazardous Locations):
1) Appleton.
2) Crouse-Hinds.
3) Killark.

6. Couplings: As supplied by conduit manufacturer.
7. Unions:
a. Concrete tight, hot-dip galvanized malleable iron.
b. Manufacturers and Products:
1) Appleton; Series SCC Bolt-On Coupling or Series EC Three-Piece Union.
2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
8. Conduit Sealing Fitting Manufacturers and Products:
a. Appleton; Type EYF, EYM, or ESU.
b. Crouse-Hinds; Type EYS or EZS.
c. Killark; Type EY or EYS.
9. Drain Seal Manufacturers and Products:
a. Appleton; Type SF.
b. Crouse-Hinds; Type EYD or EZD.
10. Drain/Breather Fitting Manufacturers and Products:
a. Appleton; Type ECDB.
b. Crouse-Hinds; ECD.
11. Expansion Fitting Manufacturers and Products:
a. Deflection/Expansion Movement:
1) Appleton; Type DF.
2) Crouse-Hinds; Type XD.
b. Expansion Movement Only:
1) Appleton; Type XJ.
2) Crouse-Hinds; Type XJ.
3) Thomas & Betts; XJG-TP.
12. Cable Sealing Fittings:
a. To form watertight nonslip cord or cable connection to conduit.
b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
c. Manufacturers and Products:
1) Appleton; CG-S.
2) Crouse-Hinds; CGBS.

B. Electric Metallic Tubing:

1. Meet requirements of UL 514B.
2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
3. Electro zinc-plated inside and out.
4. Raintight.

5. Coupling Manufacturers and Products:
    a. Appleton; Type 95T.
    b. Crouse-Hinds.
    c. Thomas & Betts.
6. Connector Manufacturers and Products:
    a. Appleton; Type 86T.
    b. Crouse-Hinds.
    c. Thomas & Betts.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type PVC, Slip-on.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
    a. Robroy Industries.
    b. Ocal.
8. Expansion Fitting Manufacturer and Product: Ocal; OCAL-BLUE XJG.

E. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
    a. Thomas & Betts; Series 5331.
    b. O-Z/Gedney; Series 4Q.

F. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Body: Galvanized steel.
3. Throat: Nylon insulated.
4. 1-1/4-Inch Conduit and Smaller: One screw body.
5. 1-1/2-Inch Conduit and Larger: Two screw body.
6. Manufacturer and Product: Appleton; Series 7400.

G. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to assure high mechanical pullout strength and watertight seal.
4. Manufacturers and Products:
   a. Carlon; Type LT.
   b. O-Z/Gedney; Type 4Q-P.
   c. Thomas & Betts; Series 6300.

H. Flexible Coupling, Hazardous Locations:

1. Approved for use in the atmosphere involved.
2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
3. Outer bronze braid and an insulating liner.
4. Conductivity equal to a similar length of rigid metal conduit.
5. Manufacturers and Products:
   a. Crouse-Hinds; Type ECGJH or ECLK.
   b. Appleton; EXGJH or EXLK.

I. Watertight Entrance Seal Device:

1. New Construction:
   a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
   b. Manufacturer and Product: O-Z/Gedney; Type FSK or WSK, as required.
2. Cored-Hole Application:
   a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
   b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.

B. Cast Metal:

1. Box: Malleable iron or cast ferrous metal.
2. Cover: Gasketed, weatherproof, malleable iron, or cast ferrous metal, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast Mounting.

5. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS or FD.
   b. Appleton; Type FS or FD.
6. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA or EAJ.
   b. Appleton; Type GR.

C. Cast Aluminum:

1. Material:
   a. Box: Cast, copper-free aluminum.
   b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
2. Hubs: Threaded.
3. Lugs: Cast mounting.
4. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS-SA or FD-SA.
   b. Appleton; Type FS or FD.
5. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA-SA.
   b. Appleton; Type GR.

D. PVC-Coated Cast Metal:

1. Type: One-piece.
2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
3. Coating:
   a. Exterior Surfaces: 40-mil PVC.
   b. Interior Surfaces: 2-mil urethane.
4. Manufacturers:
   a. Robroy Industries.
   b. Ocal.

2.04 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Large Cast Metal Box, Hazardous Locations:

1. NEMA 250 Type 7 or Type 9 as required for Class, Division, and Group involved.
2. Box: Cast ferrous metal, electro-galvanize finished or copper-free aluminum with drilled and tapped conduit entrances.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers and Products:
   a. Crouse-Hinds; Type EJB.
   b. Appleton; Type JBEW.

E. Large Stainless Steel Box:

1. NEMA 250 Type 4X.
2. Box: 14-gauge, ASTM A240/A240M, Type 316 stainless steel, with white enamel painted interior mounting panel.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.

F. Large Steel Box:

1. NEMA 250 Type 12.
2. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Owner.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.

2.05 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.
2. Spare Terminal Points: 25 percent, minimum.

2.06 SURFACE METAL RACEWAY

A. General:

1. Meet requirements of UL 5.
2. Material: Two-piece, code-gauge steel.
3. Finish: Factory applied rust inhibiting primer and gray semi-gloss finish suitable for field painting.
4. Configuration: Single, 1-17/32-inch by 2-3/4-inch section, unless otherwise indicated.

B. Fittings and Accessories:

1. Wire clips at 30 inches on-centers.
2. Couplings, cover clips, supporting clips, ground clamps, elbows as required and to comply with manufacturer’s recommendations.

C. Outlets:

1. Provide brackets or devices covers as required to support wiring devices indicated.
2. Wiring Devices and Device Plates: See Section 26 27 26, Wiring Devices.
3. Manufacturers:
   a. The Wiremold Co.
   b. Walker.

2.07 METAL WIREWAYS

A. Meet requirements of UL 870.

B. Type:

1. Indoor: Steel-enclosed, lay-in type.
2. Outdoor: Stainless-enclosed, lay-in type.

C. Cover: Removable, screw type.

D. Rating:

1. Indoor raintight, NEMA Type 3R.
2. Outdoor: Raintight, corrosion resistant, NEMA Type 4X.

E. Finish:

1. Indoor: Hot-dipped galvanized.
2. Outdoor: Stainless steel.

F. Hardware:

1. Indoor: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.
2. Outdoor: Stainless steel.

G. Knockouts: Without knockouts, unless otherwise indicated.

H. Manufacturers:

1. Circle AW.
2. Hoffman.
3. Square D.

2.08 PRECAST MANHOLES AND HANDHOLES

A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.

B. Loading: AASHTO, H-20 in accordance with ASTM C857.

C. Access: Provide cast concrete 6- or 12-inch risers and access hole adapters between top of manhole and finished grade at required elevations.

D. Drainage:

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.

E. Raceway Entrances:

1. Provide on all four sides.
2. For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.
3. At entrances where raceways are to be installed by others, provide minimum 12-inch high by 24-inch wide knockout panels for future raceway installation.

F. Embedded Pulling Iron:

1. Material: 3/4-inch diameter stock, fastened to overall steel reinforcement before concrete is placed.

2. Location:
    a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
    b. Floor: Centered below manhole or handhole cover.

G. Cable Racks:

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.
2. Wall Attachment:
    a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
    b. Insert Spacing: Maximum 3-foot on center entire inside perimeter of manhole.
    c. Arrange so that spare raceway ends are clear for future cable installation.

H. Manhole Frames and Covers:

1. Material: Machined cast iron.
2. Diameter: 36-1/2 inches.
3. Cover Type: Indented, solid top design, with two drop handles each.
4. Cover Loading: AASHTO H-20.
5. Cover Designation: Cast, on upper side, in integral letters, minimum 2 inches in height, appropriate titles:
    a. 600 Volts and Below: ELECTRIC LV.
    b. TELEPHONE.

I. Handhole Frames and Covers:

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, bolt-on, hinged or torsion spring, of checkered or diamond design.
3. Cover Loading: AASHTO H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
    a. 600 Volts and Below: ELECTRIC LV.
    b. TELEPHONE.

J. Hardware: Type 316 stainless steel.

K. Furnish knockout for ground rod in each handhole and manhole.

L. Manufacturers:

1. Utility Vault Co.
2. Penn-Cast Products, Inc.
3. Concrete Conduit Co.
4. Associated Concrete Products, Inc.
5. Pipe, Inc.

2.09 ACCESSORIES

A. Duct Bank Spacers:

1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturers:
   a. Underground Device, Inc.
   b. Carlon.

B. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nonferrous metal, nylon, or polyethylene.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 3 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.
   e. Identifying Letters: Minimum 1-inch high permanent black lettering imprinted continuously over entire length.
   f. Manufacturers and Products:
      1) Panduit; Type HTDU.
      2) Reef Industries; Terra Tape.
3. Buried Raceway Marker:
   a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
   b. Designation: Incise to depth of 3/32 inch, ELECTRIC CABLES, in letters 1/4-inch high.
   c. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.

C. Raceway Coating: Clean and paint in accordance with Section 09 90 00, Painting and Coating.

D. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.
4. Manufacturer: Raychem.

PART 3 EXECUTION

3.01 GENERAL

A. Conduit and Tubing sizes shown are based on the use of copper conductors.

B. All installed Work shall comply with NECA Installation Standards.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45-degree, 3/4-inch chamfer at all exposed edges.

G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

I. Group raceways installed in same area.

J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

M. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

N. Install watertight fittings in outdoor, underground, or wet locations.

O. Paint threads and cut ends, before assembly of fittings, galvanized conduit, or PVC-coated galvanized conduit installed in exposed or damp locations, with zinc-rich paint or liquid galvanizing compound.

P. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

Q. Do not install raceways in concrete equipment pads, foundations, or beams.

R. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

S. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

T. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of EIA/TIA 596-A.

U. Rigid galvanized steel conduit shall be used at all locations (underground and within structures) as raceways for shielded process instrumentation wiring, shielded control wiring, and shielded AFD cable, and data highway wiring. Except corrosive areas shall be PVC-coated rigid galvanized steel conduit.

V. All conduit of a given type shall be the product of one manufacturer.

3.02 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum Cover: 2 inches, including all fittings.

B. Conduit placement shall not require changes in reinforcing steel location or configuration.

C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.

D. Slabs and Walls:

1. Trade size of conduit not to exceed one-fourth of the slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.

6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

E. Columns and Beams:

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.03 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed: Rigid galvanized steel.

C. Interior, Exposed: Rigid galvanized steel.

D. Interior, Concealed (Not Embedded in Concrete):

1. Rigid galvanized steel.
2. Electric metallic tubing (administrative areas only).

E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors:

1. Rigid galvanized steel.
2. PVC Schedule 40.

F. Direct Earth Burial:

1. PVC-coated rigid galvanized steel.
2. PVC Schedule 40.

G. Concrete-Encased Raceways:

1. Rigid galvanized steel.
2. PVC Schedule 40.

H. Under Slabs-On-Grade: PVC Schedule 40.

I. Corrosive Areas:

1. PVC Schedule 80 (Interior).
2. PVC-coated rigid galvanized steel (Exterior, Exposed).

J. Hazardous Areas:

1. Rigid galvanized steel.
2. PVC-coated rigid galvanized steel.

3.04 CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Corrosive Areas: Flexible, nonmetallic liquid-tight.
4. Wet or Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
6. Length: 18-inch minimum, 60-inch maximum, sufficient to allow movement or adjustment of equipment.

B. Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Transition from Underground to Exposed: PVC-coated rigid galvanized steel conduit.

E. Transition from Concrete Embedded to Exposed: Rigid galvanized steel conduit.

F. Under Equipment Mounting Pads: Rigid galvanized steel conduit.

G. Exterior Light Pole Foundations: Rigid galvanized steel conduit.

3.05 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating.

D. Apply heat shrinkable tubing to metallic conduit protruding through concrete floor slabs to a point 6 inches above and 12 inches below concrete surface.

E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
    a. Provide a watertight seal.
    b. Without Concrete Encasement: Install watertight entrance seal device on each side.
    c. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
    d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
    e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Heating, Ventilating, and Air Conditioning Equipment:
    a. Penetrate equipment in area established by manufacturer.
    b. Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
    c. Seal penetration with Type 5 sealant—One-part Polyurethane, Immersible:
        1) Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
        2) Capable of being continuously immersed in water.
        3) Manufacturers and Products for Nonsag:
            a) Sika Chemical Corp.; Sikaflex-1a.
            b) Tremco; Vulkem 116.
        4) Manufacturers and Products for Self-leveling:
            a) BASF; MasterSeal, SL-1.
            b) Tremco; Vulkem 45.
            c) Sika Chemical Corp.; Sikaflex 1c SL.
4. Corrosive-Sensitive Areas:
    a. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
    b. Seal penetration with Type 5 sealant, as specified.
5. Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.

6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
    a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
    b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
7. Manholes and Handholes:
    a. Metallic Raceways: Provide insulated grounding bushings.
    b. Nonmetallic Raceways: Provide bell ends flush with wall.
    c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.06 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 8 feet. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.

C. Application/Type of Conduit Strap:

1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
2. Nonmetallic Conduit: Stainless steel or PVC-coated metal.
3. PVC-Coated Rigid Steel Conduit: Stainless steel PVC-coated metal.

D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.
5. Location/Type of Hardware:
    a. Dry, Noncorrosive Areas: Galvanized.
    b. Wet, Noncorrosive Areas: Stainless steel.
    c. Corrosive Areas: Stainless steel.

E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.07 BENDS

A. Install concealed raceways with a minimum number of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall not be less than 20 times cable diameter, 15 inches, minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. Degree Bends: Provide rigid galvanized steel elbows, PVC-coated where direct buried.
3. Use manufacturer’s recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 EXPANSION/DEFLECTION FITTINGS

A. Provide on all raceways at all structural expansion joints, and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer’s instructions.

3.09 PVC CONDUIT

A. Solvent Welding:

1. Provide manufacturer recommended solvent; apply to all joints.
2. Install such that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit: PVC female adapter.

C. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.10 PVC-COATED RIGID STEEL CONDUIT

A. Install in accordance with manufacturer’s instructions.

B. Tools and equipment used in the cutting, bending, threading and installation of PVC-coated rigid steel conduit shall be designed to limit damage to the PVC coating.

C. Provide PVC boot to cover all exposed threading.

3.11 WIREWAYS

A. Install in accordance with manufacturer’s instructions.

B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.
2. Nonmetallic wireway in indoor wet, outdoor, and corrosive locations.

3.12 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Provide manufacturer’s premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4X boxes and enclosures.
2. Rigid Galvanized Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
6. PVC Schedule 40 and 80 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.
7. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquidtight, metallic connectors.

D. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

3.13 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

I. Metallic Raceway Coating: Along entire length, coat with raceway coating.

J. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

K. Provide deflectional/expansion fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be rigid galvanized steel.

L. Concrete Encasement:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.
2. Concrete Color: Red.

M. Backfill:

1. As specified in Section 31 23 23.15, Trench Backfill.
2. Do not backfill until inspected by Engineer.

3.14 OUTLET AND DEVICE BOXES

A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
    a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Switch: Install on latch side of doors.
4. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
    a. Dimensions given to centerline of box.
    b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference. Do not straddle CMU block or other construction joints.
2. Light Switch: 48 inches above floor.
3. Thermostat: 54 inches above floor.
4. Telephone Outlet: 6 inches above counter tops or 18 inches above floor.
5. Wall Mounted Telephone Outlet: 52 inches above floor.
6. Convenience Receptacle:
    a. General Interior Areas: 18 inches above floor.
    b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of splashback, or 6 inches above counter tops without splashback.
    c. Industrial Areas, Workshops: 48 inches above floor.
    d. Outdoor, All Areas: 24 inches above finished grade.
7. Special-Purpose Receptacle: 48 inches above floor or as shown.
8. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Install plumb and level.

F. Flush Mounted:

1. Install with concealed conduit.
2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

G. Support boxes independently of conduit by attachment to building structure or structural member.

H. Install bar hangers in frame construction or fasten boxes directly as follows:

1. Wood: Wood screws.
2. Concrete or Brick: Bolts and expansion shields.
3. Hollow Masonry Units: Toggle bolts.
4. Steelwork: Machine screws.

I. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

J. Provide plaster rings where necessary.

K. Boxes embedded in concrete or masonry need not be additionally supported.

L. Install galvanized mounting hardware in industrial areas.

M. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

N. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

O. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.

3.15 JUNCTION AND PULL BOXES

A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

B. Install pull boxes where necessary in raceway system to facilitate conductor installation.

C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.

F. Installed boxes shall be accessible.

G. Do not install on finished surfaces.

H. Install plumb and level.

I. Support boxes independently of conduit by attachment to building structure or structural member.

J. Install bar hangers in frame construction or fasten boxes directly as follows:

1. Wood: Wood screws.
2. Concrete or Brick: Bolts and expansion shields.
3. Hollow Masonry Units: Toggle bolts.
4. Steelwork: Machine screws.

K. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

L. Boxes embedded in concrete or masonry need not be additionally supported.

M. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

N. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

O. Install drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

3.16 MANHOLES AND HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

B. Do not install until final raceway grading has been determined.

C. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

D. Grounding: As specified in Section 26 05 26, Grounding and Bonding for Electrical Systems.

E. Identification: Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.

F. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet 0 inch. Supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation.

3.17 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.18 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. Install at each termination, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
3. Provide noncorrosive wire or nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.

C. Buried Raceway Markers:

1. Install at grade to indicate direction of underground raceways.
2. Install at all bends and at intervals not exceeding 100 feet in straight runs.
3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.19 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.

C. Touchup painted conduit threads after assembly to cover nicks or scars.

D. Touchup coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturer’s instructions until time of use.

END OF SECTION

SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
   b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. 1584, Guide for Performing Arc Flash Hazard Calculations.
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety in the Workplace.
5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

A. Action Submittals:

1. Short circuit study.
2. Protective Device Coordination Study.
3. Arc flash study.
4. Arc flash warning labels.
5. Power company correspondence and contact information.

1.03 QUALITY ASSURANCE

A. Short circuit, protective device coordination, and arc flash studies shall be prepared by a professional electrical engineer registered in the State of Alabama, and in accordance with IEEE 242 and IEEE 399.

B. The short circuit, coordination, and arc-flash studies shall be signed and sealed by a professional electrical engineer registered in the State of Alabama.

1.04 SPECIAL PROJECT REQUIREMENTS

A. The complete short circuit protection device coordination and arc-flash studies must be submitted, reviewed, and approved before the Engineer will approve any Shop Drawings for any major electrical equipment. It is imperative that the Electrical Subcontractor begin this Work immediately after award of the contract. This task requires extensive coordination and work with numerous vendors. Failure of the Electrical Subcontractor to provide the initial, completed short circuit device coordination and arc-flash studies before any Shop Drawings for any major electrical equipment will result in rejecting the Shop Drawings without review.

1.05 SEQUENCING AND SCHEDULING

A. Complete short circuit protection device coordination and arc flash studies shall be submitted, reviewed, and approved before Engineer will review Shop Drawings for switchgear, motor control centers, panelboards, or standby generators.

B. The short circuit, protective device coordination, and arc flash studies shall be updated prior to Project Substantial Completion. Utilize characteristics as-installed equipment and materials.

C. Submit final arc flash labels described herein and in compliance with NEMA Z535.4, NFPA-70, NFPA-70E, and OSHA with studies.

1.06 GENERAL

A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.

B. Perform studies using electrical engineering software packages (SKM Power Tools for Windows), and verify results with handwritten computations.

C. Perform complete phase and ground fault calculations for each proposed source combination.

1. Source combination to include present and future power company supply circuits, large motors, or generators. Obtain and verify with the power company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the study submittal.

D. Utilize all proposed load data for the study obtained from Contract Documents.

E. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.07 SHORT CIRCUIT STUDY

A. General:

1. Prepare in accordance with IEEE 399.
2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
4. Use cable and bus resistances calculated at 25 degrees C.
5. Use medium voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN and XHHW conductors.
7. Use transformer impedances 92.5 percent of “nominal” impedance based on tolerances specified in IEEE C57.12.00.

B. Provide:

1. Calculation methods and assumptions.
2. Typical calculation.
3. Tabulations of calculated quantities.
4. Results, conclusions, and recommendations.
5. Selected base per unit quantities.
6. One-line diagrams.
7. Source impedance data, including electric utility system and motor fault contribution characteristics.
8. Impedance diagrams.
9. Zero-sequence impedance diagrams.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:

1. All branch circuit panelboards.
2. All 3-phase control panels.
3. Other significant locations throughout the system.

D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.

E. Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.

F. Verify:

1. Equipment and protective devices are applied within their ratings.
2. Adequacy of switchgear motor control centers and panelboard bus bars to withstand short circuit stresses.
3. Adequacy of transformer windings to withstand short circuit stresses.
4. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.

G. Tabulations:

1. General Data:
    a. Short circuit reactances of rotating machines.
    b. Cable and conduit material data.
    c. Bus data.
    d. Transformer data.
    e. Circuit resistance and reactance values.
2. Short Circuit Data (for each source combination):
    a. Fault impedances.
    b. X to R ratios.
    c. Asymmetry factors.
    d. Motor contributions.
    e. Short circuit kVA.
    f. Symmetrical and asymmetrical fault currents.
3. Equipment Evaluation:
    a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
    b. Maximum fault current available.

H. Written Summary:

1. Scope of studies performed.
2. Explanation of bus and branch numbering system.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.

I. Suggest changes and additions to equipment rating and/or characteristics.

J. Notify Engineer and Owner in writing of existing circuit protective devices improperly rated for new fault conditions.

K. Revise data for “as-installed” condition.

1.08 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
    a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
    b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to six.
    c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
    d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
    e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility’s relays.
2. Electric utility’s fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
3. Low voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
4. Low-voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
5. Pertinent transformer full-load currents at 100 and 600 percent.
6. Transformer magnetizing inrush currents.
7. Transformer damage curves.
8. ANSI transformer withstand parameters.
9. Significant symmetrical and asymmetrical fault currents.
10. Motor overload relay settings.
11. Ground fault protective device settings.
12. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
13. Generator short circuit document curves and thermal limit curves.

C. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
2. Secondary Line-To-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

D. Separate medium voltage low-voltage relay and circuit breakers characteristics curves from curves for other devices by at least 0.4-second time margin.

E. Tabulate Recommended Protective Device Settings:

1. Relays:
   a. Current tap.
   b. Time dial.
   c. Instantaneous pickup.
   d. Electronic setting data file.
2. Circuit Breakers:
   a. Adjustable pickups.
   b. Adjustable time-current characteristics.
   c. Adjustable time delays.
   d. Adjustable instantaneous pickups.
   e. I^2t In/Out.
   f. Electronic setting data file.
3. Generator Relays:
   a. Differential.
   b. Overcurrent with voltage restraint.
   c. Ground.
   d. Under voltage.
   e. Reverse power.
   f. Unbalanced loading on open phase.
   g. Loss of excitation.

F. Written Summary:

1. Scope of studies performed.
2. Summary of protective device coordination methodology.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of coordination study.
6. Comments or suggestions.
7. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.

1.09 ARC FLASH STUDY

A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed. Maximum acceptable Arch Flash Hazard incident energy level shall be 8 cal/cm^2, utilizing the arc flash reduction maintenance switches on the low voltage switchgear.

B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

C. Base Calculation: For each major part of the electrical power system, determine the following for both the normal and maintenance operation:

1. Arc flash hazard:
    a. Arc flash hazard protection boundary.
    b. Incident energy level.
2. Shock Hazard:
    a. Limited approach boundary.
    b. Restricted approach boundary.
    c. Prohibited approach boundary.
    d. Bus voltage.
    e. Glove class.

D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.

1. Bus name.
2. Calculation method.
3. Label expiration date.
4. Reference to NFPA 70E for PPE requirements.

E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:

1. Bus name.
2. Upstream protective device name, type, and settings.
3. Bus line to line voltage.

F. Produce arc flash evaluation summary sheet listing the following additional items:

1. Bus name.
2. Upstream protective device name, type, settings.
3. Bus line to line voltage.
4. Bus bolted fault.
5. Protective device bolted fault current.

6. Arcing fault current.
7. Protective device trip/delay time.
8. Breaker opening time.
9. Solidly grounded column.
10. Equipment type.
11. Gap.
12. Arc flash boundary.
13. Working distance.
14. Incident energy.
15. Required protective fire rated clothing type and class.
16. Table of required PPE.

G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm^2. Propose approaches to reduce the energy levels.

H. Prepare a report summarizing the arc flash study with conclusions and recommendations which may affect the integrity of electric power distribution system. As a minimum, include the following in the report:

1. Equipment manufacturer’s information used to prepare study.
2. Assumptions made during study.
3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
4. Arc flash evaluations summary spreadsheet.
5. Bus detail sheets.
6. Arc flash warning labels printed in color on adhesive backed labels.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

A. Printed in multi-color on adhesive backed labels or laminated plastic and be riveted on equipment.

PART 3 EXECUTION

3.01 GENERAL

A. Adjust relay and protective device settings according to values established by coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

C. Notify Engineer in writing of required major equipment modifications.

D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.

E. Provide arc flash warning labels on equipment as specified in this section.

F. If the thermal magnetic circuit breaker characteristic curves cannot be separated by the minimum 0.4-second time margin, then circuit breakers 40 amp and larger shall be replaced with electronic trip circuit breakers to achieve the required separation.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D665, Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
   b. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
   c. D923, Standard Practices for Sampling Electrical Insulating Liquids.
   d. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
   e. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
   f. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
   g. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
   h. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
   i. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
   j. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
   k. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
   l. D2285, Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop-Weight Method.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
   b. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1): Normal Measurements.
   c. 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.

d. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
e. C2, National Electrical Safety Code.
f. C37.20.1, Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
g. C37.20.2, Standard for Metal-Clad Switchgear.
h. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
i. C62.33, Test Specifications for Varistor Surge-Protective Devices.

3. National Electrical Manufacturers Association (NEMA):
   a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
4. InterNational Electrical Testing Association (NETA): Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (ATS).
5. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.
   c. 101, Life Safety Code.
6. National Institute for Certification in Engineering Technologies (NICET).
7. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
   a. Schedule for performing inspection and tests.
   b. List of references to be used for each test.
   c. Sample copy of equipment and materials inspection form(s).
   d. Sample copy of individual device test form.
   e. Sample copy of individual system test form.
2. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:

3. Operation and Maintenance Data:
    a. In accordance with Section 01 78 23, Operation and Maintenance Data.
    b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Professional Engineer registered in the State of Alabama to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment here in listed has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment shall be:

1. Scheduled with Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Owner at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Tests specified in this section shall be performed in accordance with requirements of Section 01 91 14, Equipment Testing and Facility Startup.

B. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer’s tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer’s recommendations.

D. Set, test, and calibrate protective relays, circuit breakers, fuses, power monitoring meters, CTs, PTs, tranducers, and other applicable devices in accordance with values established by the short circuit , coordination and harmonics studies as specified in Section 26 05 70, Electrical Systems Analysis.

E. Adjust mechanisms and moving parts of equipment for free mechanical movement.

F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents and approved Submittals.

H. Realign equipment not properly aligned and correct unlevelness.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer’s recommendations, or as otherwise specified in NETA ATS.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Inform Engineer of working clearances not in accordance with NFPA 70.

N. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer’s instructions.
3. Damaged electrical equipment.

O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
    a. Provide matching paint and touchup scratches and mars.
    b. If required due to extensive damage, as determined by Engineer, refinish entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day. Submit Voltage Field Test Report within 5 days of test.
4. Unbalance Corrections:
    a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
    b. Obtain a written certification from a responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer’s instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer’s instructions for proper torque values.
5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Each phase of each bus section.
   c. Phase-to-phase and phase-to-ground for 1 minute.
   d. With breakers open.
   e. With breakers closed.
   f. Control wiring except that connected to solid state components.
   g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Ground continuity test ground bus to system ground.

3.04 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 100.14.

d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
e. Insulation resistance test results to compare within 1 percent of adjacent windings.

2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.05 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 4 and larger for:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
   d. Color coding conformance with Specifications.
   e. Proper circuit identification.
2. Mechanical Connections For:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables For:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables For:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 4 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
   b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.06 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Phase-to-phase and phase-to-ground for 1 minute on each pole.
   c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each switch blade and fuse holder.
   b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.07 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 100 amperes and larger.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.

7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
   b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
   c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
   d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
   a. Contact resistance in microhms across each pole.
   b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
   a. Long-time minimum pickup and delay.
   b. Short-time pickup and delay.
   c. Ground fault pickup and delay.
   d. Instantaneous pickup by run-up or pulse method.
   e. Trip characteristics of adjustable trip breakers shall be within manufacturer’s published time-current characteristic tolerance band, including adjustment factors.
   f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS Table 100.7.
   g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS Table 100.8.

3.08 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.

2. Verify mechanically:
    a. Grounding and shorting connections have good contact.
    b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
    a. Insulation resistance test of transformer and wiring-to-ground at 1,000 volts dc for 30 seconds.
    b. Polarity test.
2. Potential Transformer Tests:
    a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9 for 1 minute on:
        1) Winding-to-winding.
        2) Winding-to-ground.
    b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

3.09 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboard, and switchgear assemblies for proper connection and tightness.
2. Ground bus connections in motor control center, panelboard, and switchgear assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
    a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system’s resistance.
    b. Main ground electrode system resistance to ground to be no greater than 5 ohms.

2. Resistance to Remote Earth:
    a. Measure the resistance to remote earth utilizing a clamp-on grounding test meter as manufactured by Greenlee or ASCO.
    b. Provide test data from four different locations spread across the Site.

3.10 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 5 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
    a. Excessive mechanical and electrical noise.
    b. Overheating.
    c. Correct rotation.
    d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
    e. Excessive vibration, in excess of values in NETA ATS Table 100.10.
5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:
    a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
        1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
        2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 and 60 seconds.
    b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
3. Insulation resistance test on insulated bearings in accordance with manufacturer’s instructions.
4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

3.11 SURGE PROTECTION DEVICE (SPD)

A. Visual and Mechanical Inspection:

1. Adequate clearances between SPDs and enclosures.
2. Ground connections to ground bus and electrode.

B. Electrical Tests:

1. Varistor Type Arrestors:
   a. Clamping voltage test.
   b. Rated RMS voltage test.
   c. Rated dc voltage test.
   d. Varistor test values in accordance with IEEE C62.33, Sections 4.4 and 4.9.

3.12 THERMOGRAPHIC SURVEY

A. Provide a thermographic survey per NETA ATS Table 100.18 of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 2 and larger at each:

1. Low voltage switchgear.
2. Low voltage motor control center.
3. Panelboard.

B. Provide a thermographic survey of feeder conductors No. 2 and larger terminating at:

1. Motors rated 50 hp and larger.
2. Low voltage disconnect switches.
3. Transfer switches.
4. Engine-generators.

C. Remove necessary enclosure metal panels and covers prior to performing survey.

D. Perform with equipment energized during periods of maximum possible loading per NFPA 70B, Section 20.17.

E. Do not perform survey on equipment operating at less than 20 percent of rated load. If plant load is insufficient, perform test with supplemental load bank producing rated load on item being measured.

F. Utilize thermographic equipment capable of:

1. Detecting emitted radiation.
2. Converting detected radiation to visual signal.
3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

G. Temperature Gradients:

1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.
3. 16 degrees C and above indicates deficiency that is to be corrected immediately.

H. Provide written report of:

1. Areas surveyed and the resultant temperature gradients.
2. Locations of areas having temperature gradients of 3 degrees C or greater.
3. Cause of heat rise and actions taken to correct the cause of heat rise.
4. Detected phase unbalance.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. This section applies only when referenced by a motor-driven equipment Specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this section will be listed in the equipment Specification. Where such deviations occur, they shall take precedence over this section.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Ratings and Fatigue Life for Roller Bearings.
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 85, Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery.
   b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
   c. 114, Standard Test Procedures for Single-Phase Induction Motors.
   d. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Motors.
   e. 841, Standard for Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – up to and Including 500 hp.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C50.41, Polyphase Induction Motors for Power Generating Stations.
   c. MG 1, Motors and Generators.
   d. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.

4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories (UL):
    a. 1, Flexible Metal Conduit.
    b. 674, Standard for Safety Electric Motors and Generators for use in Division 1 Hazardous (Classified) Locations.
    c. 2111, Overheating Protection for Motors.

1.03 DEFINITIONS

A. CISD-TEFC: Chemical industry, severe-duty enclosure.

B. DIP: Dust-ignition-proof enclosure.

C. EXP: Explosion-proof enclosure.

D. ODP: Open drip-proof enclosure.

E. TEFC: Totally enclosed, fan cooled enclosure.

F. TENV: Totally enclosed, nonventilated enclosure.

G. WPI: Open weather protected enclosure, Type I.

H. WPII: Open weather protected enclosure, Type II.

I. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

J. Inverter Duty Motor: Motor meeting all applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

1.04 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Nameplate data in accordance with NEMA MG 1.
3. Additional Rating Information:
    a. Service factor.
    b. Locked rotor current.
    c. No load current.
    d. Safe stall time for motors 200 hp and larger.
    e. Multispeed load classification (e.g., variable torque).

f. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.
g. Guaranteed minimum full load efficiency and power factor.

4. Enclosure type and mounting (e.g., horizontal, vertical).
5. Dimensions and total weight.
6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
7. Bearing type.
8. Bearing lubrication.
9. Bearing life.
10. Space heater voltage and watts.
11. Description, ratings, and wiring diagram of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.
13. Maximum brake horsepower required by the equipment driven by the motor.
14. Description and rating of submersible motor moisture sensing system.
15. Seismic anchorage and bracing data sheets and drawings as required by Section 01 88 15, Seismic Anchorage and Bracing.

B. Informational Submittals:

1. Factory test reports, certified.
2. Seismic anchorage and bracing calculations as required by Section 01 88 15, Seismic Anchorage and Bracing.
3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. General Electric.

B. Reliance Electric.

C. Baldor.

D. TECO-Westinghouse Motor Co.

2.02 GENERAL

A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

B. In order to obtain single source responsibility, utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.

C. Meet requirements of NEMA MG 1.

D. Frame assignments in accordance with NEMA MG 13.

E. Provide motors for hazardous (classified) locations that conform to UL 674 and have an appropriate listing mark by a NRTL.

F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

G. Lifting lugs on all motors weighing 100 pounds or more.

H. Operating Conditions:

1. Maximum ambient temperature not greater than 40 degrees C.
2. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

A. As designated in motor-driven equipment Specifications.

B. Constant Speed Applications: Brake horsepower of the driven equipment at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

2.04 SERVICE FACTOR

A. Inverter-duty Motors: 1.0 at rated ambient temperature, unless otherwise noted.

B. Other Motors: 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.05 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60-Hz.

B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specifications:

Size	Voltage	Phases
1/2 hp and smaller	115	1
3/4 hp and larger	460	3

C. Suitable for full voltage starting.

D. 50 hp and larger also suitable for reduced voltage starting with 65 and/or 80 percent voltage tap settings on reduced inrush motor starters.

E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.06 EFFICIENCY AND POWER FACTOR

A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:

1. Efficiency: Premium efficiency.
2. Power Factor: High power factor.

2.07 LOCKED ROTOR RATINGS

A. Locked rotor kVA Code F or lower, if motor horsepower not covered by NEMA MG 1 tables.

B. Safe stall time 12 seconds or greater.

2.08 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer’s standard winding insulation system.

B. Motors Rated Over 600 Volts: Sealed windings in accordance with NEMA MG 1.

C. Three-Phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specifications, Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP motors which must be Class B with Class B rise.

D. Motors With Form-Wound Coils: Locked coil bracing system in accordance with NEMA C50.41.

2.09 ENCLOSURES

A. Enclosures to conform to NEMA MG 1.

B. TEFC and TENV: Furnish with a drain hole with porous drain/weather plug.

C. Explosion-Proof (EXP):

1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group C and D hazardous locations.
2. Drain holes with drain and breather fittings.
3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
4. Terminate thermostat leads in terminal box separate from main terminal box.

D. Dust-Ignition-Proof (DIP):

1. TEFC listed to met UL 674 and NFPA 70 requirements for Class II, Division 1, Group E, F, and G.
2. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
3. Thermostat leads to terminate in a terminal box separate from main terminal box.

E. Submersible: In accordance with Article Special Motors.

F. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with Article Special Motors.

2.10 TERMINAL (CONDUIT) BOXES

A. Oversize main terminal boxes for all motors.

B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.

C. Except ODP, furnish gaskets between box halves and between box and motor frame.

D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	**Horsepower**	**Percentage**
Below 600	15 through 125	500
Below 600	150 through 300	275
Below 600	350 and larger	225

E. Terminal for connection of equipment grounding wire in each terminal box.

2.11 BEARINGS AND LUBRICATION

A. Horizontal Motors:

1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
2. 1 hp and Larger: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

B. Vertical Motors:

1. Thrust Bearings:
   a. Antifriction bearing.
   b. Manufacturer’s standard lubrication 100 hp and smaller.
   c. Oil lubricated 125 hp and larger.
   d. Minimum 50,000 hours L-10 bearing life.

2. Guide Bearings:
    a. Manufacturer’s standard bearing type.
    b. Manufacturer’s standard lubrication 150 hp and smaller.
    c. Oil lubricated 200 hp and larger.
    d. Minimum 100,000 hours L-10 bearing life.

C. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

D. Oil Lubrication Systems:

1. Oil reservoirs with sight level gauge.
2. Oil fill and drain openings with opening plugs.
3. Provisions for necessary oil circulation and cooling.

E. Bearing Isolation: Motors rated for inverter duty shall have electrically isolated bearings to prevent stray current damage. AEGIS bearing protection rings or approved equal.

2.12 NOISE

A. Measured in accordance with IEEE 85 and NEMA MG 1.

B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1, Part 7.

2.14 EQUIPMENT FINISH

A. Protect Motor for Service Conditions:

1. ODP Enclosures: Indoor industrial atmospheres.
2. Other Enclosures: Outdoor industrial atmospheres, including moisture and direct sunlight exposure.

B. External Finish: Prime and finish coat manufacturer’s standard.

C. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Stainless steel on motors with ODP, WPI, and WPII enclosures meeting requirements for Guarded Machine in NEMA MG 1, and attached with stainless steel screws.

B. Winding Thermal Protection:

1. Thermostats:
   a. Motors for constant speed application 25 hp through 70 hp. Motors for adjustable speed application 5 hp through 70 hp.
   b. Bi-metal disk or rod type thermostats embedded in each stator phase windings.
   c. Automatic reset contacts rated 120 volts ac, 5 amps minimum, opening on excessive temperature. (Manual reset shall be provided at motor controller.)
   d. Leads extending to separate terminal box for motors 100 hp and larger.
2. Thermistors:
   a. Motors for constant speed application larger than 70 hp. Motors for adjustable speed application larger than 70 hp.
   b. Thermistor embedded in each stator phase winding before winding dip and bake process.
   c. In intimate contact with winding conductors.
   d. Epoxy-potted, solid state thermistor control module mounted in NEMA 250, Type 4 box on motor by motor manufacturer.
   e. Individual thermistor circuits factory-wired to control module.
   f. Control module rated for 120V ac power supply.
   g. Control module automatically reset contact for external use rated 120 volts ac, 5 amps minimum, opening on abnormally high winding temperature. Manual reset shall be provided at motor controller.

C. Vibration detection relay mounted in NEMA 250, Type 4X enclosure on side of motor.

D. Space Heaters:

1. Provide winding space heaters with leads wired out to separate condulet or terminal box.
2. Provide extra hole or hub on motor terminal box as required.
3. Unless shown otherwise, heater shall be suitable for 120V ac supply, with wattage suitable for motor frame size.

E. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to also display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

F. Anchor Bolts: Provide anchor bolts meeting manufacturer’s recommendations and of sufficient size and number for the specified seismic conditions.

2.16 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Chemical Industry, Severe-Duty (CISD-TEFC):

1. In accordance with IEEE 841.
2. TEFC in accordance with NEMA MG 1.
3. Suitable for indoor or outdoor installation in severe-duty applications including high humidity, chemical (corrosive), dirty, or salty atmospheres.
4. Motor Frame, End Shields, Terminal Box, and Fan Cover: Cast iron.
5. Ventilating Fan: Corrosion-resistant, nonsparking, external.
6. Drain and Breather Fittings: Stainless steel.
7. Nameplate: Stainless steel.
8. Gaskets between terminal box halves and terminal box and motor frame.
9. Extra slinger on rotor shaft to prevent moisture seepage along shaft into motor.
10. Double shielded bearings.
11. 125,000 hours minimum L-10 bearing life for direct-connected loads.
12. External Finish: Double-coated epoxy enamel.
13. Coated rotor and stator air gap surfaces.
14. Insulation System, Windings, and Connections:
    a. Class F insulation, Class B rise or better at 1.0 service factor.
    b. Multiple dips and bakes of nonhygroscopic polyester varnish.
15. Service Factor:
    a. At 40 Degrees C Ambient: 1.15.
    b. At 65 Degrees C Ambient: 1.00.
16. Safe Stall Time Without Injurious Heating: 20 seconds minimum.

C. Severe-Duty Explosion-Proof: Meet requirements for EXP enclosures and CISD-TEFC motors.

D. Severe-Duty, Dust-Ignition-Proof: Meet requirements for DIP enclosures and CISD-TEFC motors.

E. Multispeed: Meet requirements for speeds, number of windings, and load torque classification indicated in the motor-driven equipment specifications.

F. Inverter Duty Motor:

1. Motor supplied power by adjustable voltage and adjustable frequency drives shall be inverter duty rated.
2. Motor shall be suitable for operation over entire speed range indicated.
3. Provide forced ventilation where speed ratio is greater than published range for motor being installed.
4. Motor installed in Division 1 hazardous (classified) locations shall be identified as acceptable for variable speed when used in a Division 1 location.

G. Inclined Motors:

1. Motors suitable for operation only in horizontal position not acceptable.
2. Bearings designed for thrust imposed by driven equipment and by motor rotor when motor is in inclined position.
3. Lubrication system designed to provide adequate bearing lubrication when motor is in inclined position.

2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors and IEEE 114 for single-phase motors.
2. Routine (production) tests on all motors in accordance with NEMA MG 1. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency and power factor at 50, 75, and 100 percent of rated horsepower:
   a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.
   b. For motors 500 hp and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by IEEE 112, Test Method F.
   c. On motors of 100 hp and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

4. Additional Required Tests: Vibration (balance).
5. Provide certified test reports for polyphase motors 50 hp and larger.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.
2. Efficiency and power factor by Test Method B, IEEE 112, Form A-2, and NEMA MG 1, Table 12-11, and Table 12-12.
3. Efficiency and power factor by Test Method F, IEEE 112, Forms F-1, F-2, and F-3.
4. Temperature Test: IEEE 112, Form A-2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s instructions and recommendations.

B. Align motor carefully and properly with driven equipment.

C. Secure equipment to mounting surface with anchor bolts.

3.02 MANUFACTURER’S SERVICES

A. Furnish manufacturer’s representative at Site in accordance with Section 01 43 33, Manufacturers’ Field Services, for installation assistance, inspection, equipment testing, and startup assistance.

B. Manufacturer’s Certificate of Proper Installation.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C57.96, Guide for Loading Dry Type Transformers.
2. National Electrical Contractor's Association (NECA): 409, Recommended Practice for Installing and Maintaining Dry-Type Transformers.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. ST 20, Dry-Type Transformers for General Applications.
   c. TP 1, Guide For Determining Energy Efficiency for Distribution Transformers.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories Inc. (UL):
   a. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   b. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 1561, Standard for Dry-Type, General Purpose, and Power Transformers.

1.02 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Dimensions and weight.
3. Transformer nameplate data.
4. Schematic and connection diagrams.

B. Informational Submittals:

1. Test Report: Sound test certification for dry type power transformers (0 to 600-volt, primary).

PART 2 PRODUCTS

2.01 GENERAL

A. UL 1561, NEMA ST 20, unless otherwise indicated.

B. Dry-type, self-cooled, two-winding, with copper windings.

C. Units larger than 5 kVA suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

D. Efficiency: Meet or exceed values in Table 4.2 of NEMA TP 1.

E. Maximum Sound Level per NEMA ST 20:

1. 40 decibels for 0 kVA to 9 kVA.
2. 45 decibels for 10 kVA to 50 kVA.
3. 50 decibels for 51 kVA to 150 kVA.
4. 55 decibels for 151 kVA to 300 kVA.
5. 60 decibels for 301 kVA to 500 kVA.

F. Overload capability: Short-term overload per IEEE C57.96.

G. Wall Bracket: For single-phase units, 15 kVA to 25 kVA, and for three-phase units, 15 kVA to 30 kVA.

H. Vibration Isolators:

1. Rated for transformer’s weight.
2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.
4. 30 kVA and Above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.

I. Contractor shall provide higher insulation rating and/or increased capacity of transformer as necessary to ensure the transformer damage curves plot in the region of TCC protected by the overcurrent protective device. For additional requirements, reference Section 26 05 70, Electrical Systems Analysis.

J. Manufacturers:

1. Square D Co.
2. Eaton/Cutler-Hammer.
3. Siemens.

2.02 GENERAL PURPOSE TRANSFORMER

A. Insulation Class: Manufacturer’s standard.

B. Temperature Rise:

1. 150 degrees C for 37.5 kVA and less.
2. 115 degrees C for greater than 37.5 kVA.

C. Core and Coil:

1. Encapsulated for single-phase units 1/2 kVA to 25 kVA and for three-phase units 3 kVA to 15 kVA.
2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.

D. Enclosure:

1. Single-Phase, 3 kVA to 25 kVA: NEMA 250, Type 3R, nonventilated.
2. Single-Phase, 37-1/2 kVA and Above: NEMA 250, Type 2, ventilated.
3. Three-Phase, 3 kVA to 15 kVA: NEMA 250, Type 3R, nonventilated.
4. Three-Phase, 30 kVA and Above: NEMA 250, Type 2, ventilated.
5. Outdoor Locations: NEMA 250, Type 3R stainless steel.
6. Corrosive Locations: NEMA 250, Type 3R stainless steel.

E. Voltage Taps:

1. Single-Phase, 3 kVA to 10 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
2. Single-Phase, 15 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
3. Three-Phase, 3 kVA to 15 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
4. Three-Phase, 30 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.

F. Impedance: 4.5 percent minimum on units 75 kVA and larger.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NECA and manufacturer’s instructions.

B. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.

C. Provide moisture-proof, flexible conduit for electrical connections.

D. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.

E. Provide wall brackets for single-phase units, 15 kVA to 167-1/2 kVA, and three-phase units, 15 kVA to 112 kVA.

END OF SECTION

SECTION 26 41 00
FACILITY LIGHTNING PROTECTION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Lightning Protection Institute (LPI): 175, Standard of Practice.
2. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 780, Standard for the Installation of Lightning Protection Systems.
3. Underwriters Laboratories, Inc. (UL):
   a. 96, Standard for Lightning Protection Components.
   b. 96A, Standard for Installation Requirements for Lightning Protection Systems.

1.02 SYSTEM REQUIREMENTS

A. Provide series 2000 structural lightning protection system design and system installation for all structures of the Plant including, but not limited to: Replacement Screen Structure.

B. The installed lightning protection system shall be in accordance with all applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.

C. Provide for UL inspection and receipt of UL 96 Master Label “C” Certification Form.

1.03 SUBMITTALS

A. Action Submittals:

1. Lightning protection system layout Drawings signed and sealed by a professional Engineer licensed in the State of Alabama.
2. Component locations.
3. Detailed plans.
4. Down conductor.
5. Connecting conductor.
6. Bond strap.
7. Air terminals.
8. Fittings.
9. Connectors.
10. Ground rods.

B. Informational Submittals:

1. Field test report.
2. Ground Witness Certification-Form LPI-175A.
3. Post-Installation Certification-Form LPI-175B.
4. UL 96 Master Label “C” Certification.

1.04 QUALITY ASSURANCE

A. Designer: Lightning protection system design shall be prepared by a professional Engineer registered in the State of Alabama.

B. System components shall be the product of a manufacturer regularly engaged in the manufacturing of lightning protection components in accordance with UL 96.

C. Lightning protection system shall be installed under direct supervision of an LPI 175 Certified Master Installer.

D. Inspection of final installation and grounding connection shall be performed by an LPI-certified inspector.

E. Provide the Work in accordance with NFPA 70 and 780. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

F. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Thompson Lightning.
2. IPC Protection.
3. Erico Eritech Lightning Protection Systems.
4. VFC, Inc.

2.02 GENERAL

A. Complete system shall bear UL 96 Master Label C.

B. System Material: Copper or high copper content, heavy-duty bronze castings, unless otherwise specified.

C. Material shall comply in weight, size, and composition for the class of structure to be protected as established by NFPA 780.

2.03 COMPONENTS

A. Air Terminal:

1. Material: Solid copper rods with tapered or blunt points as required for application.
2. Length: Sufficient to extend minimum 10 inches above object being protected.
3. UL 96 Label B applied to each terminal.

B. Conductors:

1. Lightning System Conductors: Bare medium hard-drawn stranded copper, or stranded aluminum as required for the application**.**
2. Main Down Conductor: Smooth twist stranding.
3. Connecting Conductor: Concentric stranding.
4. Bonding Conductor: Flexible strap.
5. Main down and connecting conductors shall bear the UL 96 Label A, applied every 10 feet.
6. Grounding Conductors: Stranded bare copper.

C. Cable Fastener And Accessories: Capable of withstanding minimum pull of 100 pounds.

D. Fittings:

1. Heavy-duty.
2. Bolts, Screws, and Related Hardware: Stainless steel.

E. Ground Rods:

1. Material: Copper.

F. Grounding Connections:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Hardware: Silicone bronze.

G. Cable Connections and Splicers:

1. Welds: Exothermic process.
2. Fasteners: Bolted clamp type, corrosion-resistant copper alloy.
3. Through-Roof Connectors: Straight or right angle with bronze and lead seal flashing washer.

H. Conduit: As specified in Section 26 05 33, Raceways and Boxes.

PART 3 EXECUTION

3.01 GENERAL

A. Workmanship shall be in accordance with all applicable provisions of LPI 175, UL 96, UL 96A, and NFPA 780.

B. Aluminum materials shall be used where required to meet the galvanic corrosion requirements of UL 96A.

C. Provide pitchpockets or method compatible with roofing to waterproof roof penetrations.

D. Install system in inconspicuous manner so components blend with building aesthetics.

E. Provide for and obtain UL 96 Master Label C Certification.

3.02 EXAMINATION

A. Verify conditions prior to installation. Actual conditions may require adjustments in air terminal and ground rod locations.

3.03 INSTALLATION

A. Air Terminals:

1. Supports: Brackets or braces.
2. Parapet Bracket Attachment: Lag or expansion bolts.

3. Secure base to roof surface with adhesive or pitch compatible with roofing bond.
4. Provide terminal flashing at roof penetrations.
5. Perimeter Terminals:
   a. Maximum Spacing: 20 feet.
   b. Maximum Distance From Outside Edge of Building: 2 feet.
6. Roof Ridge Terminals: Maximum spacing 20 feet.
7. Mid-Roof Terminals: Maximum spacing 50 feet.
8. Provide blunt point air terminals for applications exposed to personnel.

B. Conductors:

1. Conceal whenever practical.
2. Provide 1-inch PVC conduit in building walls or columns for main downleads and roof risers.
3. Support: Maximum spacing for exposed conductors.
   a. Vertical: 3 foot.
   b. Horizontal: 4 foot.
4. Maintain horizontal and vertical conductor courses free from dips or pockets.
5. Bends: Maximum 90 degrees, with minimum 8-inch radius.
6. Install air terminal conductors on the structural roof surface before roofing composition is applied.

C. Bonding:

1. Bond to Main Conductor System:
   a. Roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
   b. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.
2. Bond each steel column or major framing members to grounding system.
3. Bond each main down conductor to grounding system.

D. Grounding Electrical System: Install in accordance with Section 26 05 26, Ground and Bonding of Electrical Systems, and as shown on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Field Testing:

1. Isolate lightning protection system from other ground conditions while performing tests.

2. Resistance: Test ground resistance of grounding system by the fall-of-potential method.
   a. Test Resistance to Ground: Maximum 3 ohms.
   b. Install additional ground rods as required to obtain maximum allowable resistance.
3. Test Report:
   a. Description of equipment tested.
   b. Description of test.
   c. Test results.
   d. Conclusions and recommendations.
   e. Appendix, including appropriate test forms.
   f. Identification of test equipment used.
   g. Signature of responsible test organization authority.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Department of Defense: MIL-STD-220C, Test Method Standard – Method of Insertion Loss Measurement.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and less) AC Power Circuits.
   c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and less) AC Power Circuits.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 497A, Standard for Secondary Protectors for Communications Circuits.
   b. 1283, Standard for Electromagnetic Interference Filters.
   c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

A. Action Submittals:

1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
2. Electrical single-line diagram showing location of each SPD.
3. Manufacturer’s UL certified test data and nameplate data for each surge protective device (SPD).

1.03 QUALITY ASSURANCE

A. UL Compliance and Labeling:

1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
2. SPDs for Telephone Circuit Protection: Comply with UL 497A.

B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Eaton, SPD Series.

B. General Electric, Tranquell.

C. Square D, Surelogic.

D. Advanced Protection Technologies, Inc.

E. CITEL, MDS Series.

2.02 GENERAL

A. All SPDs for power circuits, provided under this section, shall be the product of a single manufacturer.

B. SPDs shall be capable of performance at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

C. SPDs components shall be individually fused to disconnect the field component from the electrical source should the suppressor fail. The fusing shall be sized to permit full surge handling capabilities while affording safety protection from thermal overloads and short circuits.

D. SPDs shall be sized for the specific type and voltage of the electrical service. Single-phase and three-phase wye-configured systems shall have True 10-mode L-L, L-N, L-G, and N-G protection. Grounded delta-configured systems shall have True 6-mode L-L and L-G protection. A physical and separate mode of surge protection shall exist in each required mode.

E. Power Filter: The SPD shall incorporate a high frequency extended range power filter complimentary listed to UL 1283 as an electromagnetic interference filter.

2.03 MOTOR CONTROL CENTERS AND PANELBOARDS

A. Provide SPDs meeting IEEE C62.41.1 and IEEE C62.41.2 for each MCC and panelboard in accordance with Category B3.

B. Surge current capacity shall be not less than the following:

1. L-L Capacity: 80 kA.
2. L-N Capacity: 80 kA.
3. L-G Capacity: 80 kA.
4. N-G Capacity: 80 kA.

C. Suppressor shall be integral to the equipment enclosure. Equipment manufacturer shall retain the services of the SPD manufacturer as an installation consultant.

D. UL 1449 maximum clamp voltage shall not be more than:

System Voltage	Phase	L-L or L-N Clamp Voltage
120	1	400
208Y/120	3	400
240	3	800
480Y/277	3	800

E. Nominal Discharge Current: 20 kA.

2.04 ANNUNCIATION

A. Provide unit or separately mounted LED-type indication lights to show the normal and failed status of each mode of protection. Provide one set of normally open and normally closed auxiliary contacts which operate when the unit fails.

2.05 SURGE COUNTER

A. Provide each SPD rated above 100 kA with a counter displaying the number of voltage transients that have occurred on the unit input. The counter shall be battery backed and retain the count through system power outages.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

A. Install SPDs where indicated on the Drawings or in the Specifications and: SPDs in each distribution panelboard unless otherwise indicated.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install suppressors according to manufacturer’s recommendations. Utilizing SPD manufacturer as an installation consultant.

B. Install suppressors directly in the cabinet which houses the equipment to be protected so that the suppressor leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Connecting wires shall be as short as possible with gently twisted conductors, tied together, to prevent separation. Connecting wires shall not exceed 12 inches in length at any point.

D. Field installed conductors shall be the same as specified for building wire, not smaller than No. 8 AWG and not larger than No. 4 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.

E. Provide dedicated disconnecting means for SPDs installed at service entrance location, switchgear, motor control centers, and panelboards. Provide dedicated 30-60-ampere molded case switches (size dependent upon wire size used) with number of poles as required, as disconnecting means.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Department of Defense: MIL-STD-220C, Test Method Standard – Method of Insertion Loss Measurement.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and less) AC Power Circuits.
   c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and less) AC Power Circuits.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 497A, Standard for Secondary Protectors for Communications Circuits.
   b. 1283, Standard for Electromagnetic Interference Filters.
   c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

A. Action Submittals:

1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
2. Electrical single-line diagram showing location of each SPD.
3. Manufacturer’s UL certified test data and nameplate data for each surge protective device (SPD).

1.03 QUALITY ASSURANCE

A. UL Compliance and Labeling:

1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
2. SPDs for Telephone Circuit Protection: Comply with UL 497A.

B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Eaton, SPD Series.

B. General Electric, Tranquell.

C. Square D, Surelogic.

D. Advanced Protection Technologies, Inc.

E. CITEL, MDS Series.

2.02 GENERAL

A. All SPDs for power circuits, provided under this section, shall be the product of a single manufacturer.

B. SPDs shall be capable of performance at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

C. SPDs components shall be individually fused to disconnect the field component from the electrical source should the suppressor fail. The fusing shall be sized to permit full surge handling capabilities while affording safety protection from thermal overloads and short circuits.

D. SPDs shall be sized for the specific type and voltage of the electrical service. Single-phase and three-phase wye-configured systems shall have True 10-mode L-L, L-N, L-G, and N-G protection. Grounded delta-configured systems shall have True 6-mode L-L and L-G protection. A physical and separate mode of surge protection shall exist in each required mode.

E. Power Filter: The SPD shall incorporate a high frequency extended range power filter complimentary listed to UL 1283 as an electromagnetic interference filter.

2.03 MOTOR CONTROL CENTERS AND PANELBOARDS

A. Provide SPDs meeting IEEE C62.41.1 and IEEE C62.41.2 for each MCC and panelboard in accordance with Category B3.

B. Surge current capacity shall be not less than the following:

1. L-L Capacity: 80 kA.
2. L-N Capacity: 80 kA.
3. L-G Capacity: 80 kA.
4. N-G Capacity: 80 kA.

C. Suppressor shall be integral to the equipment enclosure. Equipment manufacturer shall retain the services of the SPD manufacturer as an installation consultant.

D. UL 1449 maximum clamp voltage shall not be more than:

System Voltage	Phase	L-L or L-N Clamp Voltage
120	1	400
208Y/120	3	400
240	3	800
480Y/277	3	800

E. Nominal Discharge Current: 20 kA.

2.04 ANNUNCIATION

A. Provide unit or separately mounted LED-type indication lights to show the normal and failed status of each mode of protection. Provide one set of normally open and normally closed auxiliary contacts which operate when the unit fails.

2.05 SURGE COUNTER

A. Provide each SPD rated above 100 kA with a counter displaying the number of voltage transients that have occurred on the unit input. The counter shall be battery backed and retain the count through system power outages.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

A. Install SPDs where indicated on the Drawings or in the Specifications and: SPDs in each distribution panelboard unless otherwise indicated.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install suppressors according to manufacturer’s recommendations. Utilizing SPD manufacturer as an installation consultant.

B. Install suppressors directly in the cabinet which houses the equipment to be protected so that the suppressor leads are straight and short, with all conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Connecting wires shall be as short as possible with gently twisted conductors, tied together, to prevent separation. Connecting wires shall not exceed 12 inches in length at any point.

D. Field installed conductors shall be the same as specified for building wire, not smaller than No. 8 AWG and not larger than No. 4 AWG. Device leads shall not be longer than the length recommended by the manufacturer, unless specifically reviewed and approved by the manufacturer.

E. Provide dedicated disconnecting means for SPDs installed at service entrance location, switchgear, motor control centers, and panelboards. Provide dedicated 30-60-ampere molded case switches (size dependent upon wire size used) with number of poles as required, as disconnecting means.

END OF SECTION

SECTION 26 50 00
LIGHTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Canadian Standards Association (CSA).
2. Certified Ballast Manufacturer (CBM).
3. Federal Communications Commission (FCC).
4. Illuminating Engineering Society of North America (IESNA).
5. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
6. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
7. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
8. Underwriters Laboratories, Inc. (UL):
   a. 595, Marine-Type Electric Lighting Fixtures.
   b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
   c. 924, Emergency Lighting and Power Equipment.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Exterior Luminaires:
      1) Catalog data sheets and pictures.
      2) Luminaire finish and metal gauge.
      3) Lens material, pattern, and thickness.
      4) IESNA lighting classification and isolux diagram.
      5) Fastening details to wall or pole.
      6) Ballast type, location, and method of fastening.
      7) For light poles, submit wind loading, complete dimensions, and finish.
   b. LED Source Systems:
      1) General:
         a) IESNA LM-80 test reports.
         b) IESNA TM-21 ratings.

c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
d) Warranty: Light engine and driver.
e) Rated life.
f) Surge protection.
g) Thermal control device, heat sink.
h) Enclosure and wiring information.
i) Operating voltage range.

c. Photo-Time Control:
1) Wiring diagram.
2) Contact ratings.

d. Photocells:
1) Voltage, and power consumption.
2) Capacity.
3) Contacts and time delay.
4) Operating levels.
5) Enclosure type and dimensions.
6) Temperature range.

2. Samples: Submit Samples of each substituted luminaire if requested by Engineer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied NRTL listing mark.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Aluminum Poles:

1. Provide manufacturer’s standard protection for the finish during shipment and installation. At minimum, spirally wrap each pole shaft with protective paper secured with tape, and ship small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1 foot above ground level and growing vegetation.

4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

1.05 EXTRA MATERIALS

1. Furnish, tag, and box for shipment and storage the following spare parts.

Item	Quantity
Spare LED and Pole of each type	One complete set(s)

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on Drawings.

B. Feed-through type, or separate junction box.

C. Ballasts: Two-lamp when possible.

D. Tandem wired for three-lamp, fluorescent fixtures.

E. Wire Leads: Minimum 18 AWG.

F. Component Access: Accessible and replaceable without removing luminaire from ceiling.

G. Exterior Installations:

1. NRTL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have NRTL label.

H. Emergency Lighting:

1. Power Pack: Self-contained, 120/277-volt dual voltage transformer, inverter/charger, sealed nickel cadmium battery, and indicator switch in accordance with UL 924.
2. Lighted, push-to-test indicator.
3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.

5. Capable of protecting against excess charging and discharging.
6. Emergency Self-Diagnostic System:
    a. Solid state device with LED display and audible alarm.
    b. Automatic and manual test unit.
    c. Test for malfunction of lamps, battery, and charger board.
    d. Manufacturer: Lithonia.

I. Hazardous Classified Areas:

1. NRTL Labeled: CLASS I, DIVISION 1, GROUPS C AND D and CLASS II, DIVISION 1, GROUPS F AND G.
2. Fixture Enclosure and Fittings: Copper-free, cast aluminum in accordance with UL 844.

2.02 LED SOURCE SYSTEMS

A. General:

1. Provide IESNA LM-80 test reports.
2. Provide Energy Star compliance for solid state luminaires.
3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
4. Provide RoHS compliant LED light source(s) and driver(s).
5. Rated operating temperature range as indicated on the Luminaire Schedule.
6. Warranty: 5 years minimum.

B. Electronic Module/Light Engine:

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device.
    a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
4. Light Engine Rating per TM-21**:** 60,000 at 65 degrees C, L84.
5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
6. Color Rendering Index (CRI): Minimum of 80.

C. Drivers:

1. Expected life of 60,000 hours at 65 degrees C.
2. Provide drivers mounted in an all metal can.

3. Operating Voltage Range: 50/60-Hz input source of 120V to 277V with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
6. Sound rating: Class A.
7. Comply with NEMA 410 for inrush current limits.

2.03 LIGHTING CONTROL

A. Photocell:

1. Automatic ON/OFF switching photo control.
2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Setting: ON at dusk and OFF at dawn.
4. Time delay feature to prevent false switching.
5. Field adjustable to control operating levels.
6. Manufacturers:
   a. Tork.
   b. Paragon Electric Company.

2.04 POLES

A. Rating (With Luminaire): 125 mph steady winds, without incurred damage.

B. Material: Steel Extruded aluminum or concrete.

2.05 EMERGENCY BALLAST

A. In accordance with UL 924.

B. Nickel cadmium battery, charger, and electronic circuitry in metal case plus ac ballast.

C. Solid state charging indicator monitoring light and double-pole test switch.

D. Capable of operating two fluorescent lamps for a period of 90 minutes with output of 1,100 to 1,200 lumens.

E. Manufacturers:

1. MagneTek Lighting Products.
2. The Bodine Co., Inc.; B50.
3. Lithonia.

2.06 IN-LINE FUSE HOLDER AND FUSE

A. Fuse Holder:

1. General: Waterproof, of corrosion-resistant material.
2. Rating: 600 volts.

B. Fuse:

1. General: Midget, dual element.
2. Rating: 5-amp, voltage as required by application.

C. Manufacturer: Methods Electronics Inc. Network, Buss Div.

PART 3 EXECUTION

3.01 LUMINAIRES

A. General:

1. Install in accordance with manufacturer’s recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.
3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.
4. Install plumb and level.
5. Mounting heights shown for pendant mounted luminaires are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.
6. Mounting heights shown for wall-mounted luminaires are measured from center of mounting plate to finished floor or finished grade, whichever is applicable.
7. Install each luminaire outlet box with galvanized stud.

B. Pole Mounted: Provide cast-in-place or precast concrete base.

C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.

3.02 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn or photocells switch time clock ON at dusk with time clock switching lights OFF at preset time as shown.

3.03 EMERGENCY LIGHTING UNIT

A. Install in accordance with manufacturer’s recommendations.

B. Provide permanent circuit connections with conduit and wire.

C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.

D. Provide separate circuit wiring to luminaire.

3.04 MANUFACTURER’S SERVICES

A. Occupancy Sensors:

1. Furnish manufacturer’s representative at Job Site in accordance with Section 01 43 33, Manufacturers’ Field Services, to inspect installation, test unit, and put into service.
2. Provide, at Owner’s facility, training necessary to familiarize Owner’s personnel with operation, use, adjustment, and problem solving diagnosis of occupancy sensing devices and systems.

3.05 CLEANING

A. Remove labels and markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touchup painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.

D. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 QUALITY ASSURANCE

A. Prior to any clearing activities, stake out permanent and temporary easements. Staking shall be provided by licensed surveyor.

B. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.03 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements. Prior approval of disposal or borrow areas is required.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.
2. Trench Excavation: 2 feet from trench excavation.
3. Fill:
   a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
   b. Stripping : 2 feet beyond toe of permanent fill.
4. Structures: 10 feet outside of new structures.
5. Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of uncontaminated debris at an approved offsite facility.
2. Dispose of contaminated debris as per Section 31 23 16, Excavation.
3. Burning of debris onsite is allowable if prior approval is obtained from the Owner and Montgomery County.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).
   b. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition; Section 31 10 00, Site Clearing; and Section 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

A. Under Earthfill: Proof roll subgrade with 6 overlapping passes using a 10-ton or heavier three-wheeled power roller. Compact upper 6 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D698

B. Under Pipelines and Manholes: Grade level and test strength of subgrade using excavator equipment as directed by Engineer to provide a firm and unyielding surface. When, in the opinion of the Engineer, the subgrade is not suitable, over excavate and correct as outlines in Article 3.04.

C. Under Pavement Structure, Access Roads, Floor Slabs, or Granular Fill Under Structures: Proof roll the subgrade with loaded dump truck or other means acceptable to Engineer to provide a firm and unyielding surface. Identify soft areas and over excavate if directed by Engineer as outlined in Article 3.04.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 CORRECTION

A. Soft or Loose Subgrade: Pipeline and Manholes: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Soft or Loose Subgrade:

1. Access Roads and Pavement Structures:
   a. Over excavate as specified in Section 31 12 16, Excavation, and replace with ALDOT No 357 crushed limestone as directed by Engineer.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock excavation.

1.02 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.03 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.04 SEQUENCING AND SCHEDULING

A. Establish all environmental erosion and sediment control devices prior to any clearing or excavation activities. Inspect and maintain all erosion and sediment control devices during all excavation activities and maintain until site has been restored.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

C. Excavation safety: The Contractor shall be solely responsible for making all excavations in a safe manner. Provide appropriate measure to retain excavation sideslopes to ensure that persons working in or near the excavation are protected.

D. Dewatering: Conform to applicable requirements of 31 23 19.01 Dewatering, prior to initiation excavation. Provide erosion and sediment control devices to protect surrounding areas from erosion from dewatering activities. Comply with all ADEM and Construction Best Management Practices Plan.

E. Shoring, Sheeting, Bracing, and sloping: Install and maintain shoring, sheeting bracing, and sloping as necessary to support the sides of the excavation to keep and to prevent any movement which may damage adjacent pavement, utilities, or structures, or damage or delay the work, or endanger life and health. Install and maintain shoring, sheeting, bracing, and sloping as required by OSHA and other applicable state and federal government regulations.

F. Excavation safety: The Contractor shall be solely responsible for making all excavations in a safe manner. Provide appropriate measures to retain excavation sideslopes to ensure that persons working in or near the excavation are protected.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not overexcavate without written authorization of Engineer.

C. Remove or protect obstructions as shown and as specified in Section 01 50 00, Temporary Facilities and Controls, Article Protection of Work and Property.

3.02 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 TRENCH WIDTH

A. Minimum Width of Trenches:

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
   a. Less than 4-inch Outside Diameter or Width: 18 inches.
   b. Greater than 4-inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
3. Increase trench widths by thicknesses of sheeting.

B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to facilities, adjacent property, or completed Work.

3.04 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.05 STOCKPILING EXCAVATED MATERIAL

A. Topsoil excavated in Jurisdictional Waters of the US (Wetland) areas should be segregated from other excavated materials to be replaced at completion of trench backfill. Do not allow topsoil to become mixed with other excavation materials.

B. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

C. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

D. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.

E. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

F. Do not stockpile any excavation materials within 25 feet of the top bank of Milley's Creek.

G. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

H. Contractor to obtain prior approval for location of stockpile areas.

I. Stockpile area shall be returned to equal or better condition than existing condition.

3.06 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite. No excess spoils are to be deposited in Jurisdictional Waters of the US (generally all areas north of Vaughn Road). on site or as specified in section 31 10 00, Site Clearing, for clearing and grubbing debris.

B. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 19.01
DEWATERING

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals: Water control plan.

1.02 WATER CONTROL PLAN

A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.

B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

B. Remove and control water during periods when necessary to properly accomplish Work.

3.02 SURFACE WATER CONTROL

A. See Section 01 50 00, Temporary Facilities and Controls, Article Temporary Controls.

B. Remove surface runoff controls when no longer needed.

3.03 DEWATERING SYSTEMS

A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2 feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.

B. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. To relieve artesian pressures and resultant uplift of excavation bottom.

C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

D. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.

E. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.04 DISPOSAL OF WATER

A. Obtain discharge permit for water disposal from authorities having jurisdiction.

B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.

C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.05 PROTECTION OF PROPERTY

A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   e. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   f. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   h. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

E. Completed Course: A course or layer that is ready for next layer or next phase of Work.

F. Lift: Loose (uncompacted) layer of material.

G. Geosynthetics: Geotextiles, geogrids, or geomembranes.

H. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

I. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1 foot outside outermost edge at base of foundations or slabs.
2. 1 foot outside outermost edge at surface of roadways or shoulder.
3. 0.5 foot outside exterior at spring line of pipes or culverts.

J. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

K. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

L. Imported Material: Materials obtained from sources offsite, suitable for specified use.

M. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

N. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

O. Standard Specifications: When referenced in this section, shall mean Alabama Department of Transportation Standard Specifications for Highway Construction, latest edition.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples: Imported material taken at source. Submit to testing Agency.

B. Informational Submittals:

1. Manufacturer’s data sheets for compaction equipment.
2. Certified test results from independent testing agency.

1.04 QUALITY ASSURANCE

A. Notify Engineer when:

1. Structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

1.05 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition;; Section 31 23 16, Excavation; and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 10, Structural Concrete. Obtain Engineer’s acceptance of concrete work and attained strength prior to placing backfill.

C. Backfill around water-holding structures only after completion of satisfactory leakage tests as specified in Section 03 30 01, Structural Concrete.

D. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests: As necessary and at such frequency as required for testing agency to determine the suitability of materials proposed for this Project.

2.02 EARTHFILL

A. Excavated material from required excavations and borrow sites, free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Material containing more than 10 percent gravel, stones, or shale particles is unacceptable.

C. Provide imported material of equivalent quality, if required to accomplish Work.

2.03 STRUCTURAL FILL

A. Excavated material from required excavations and designated borrow sites.

1. USCS Classification: SM, SC, SM-ML, or ML in accordance with ASTM D2487.
2. Free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.
3. Maximum Fine Content (Percent Passing No. 200 sieve): 49.
4. Maximum Liquid Limit: 45.
5. Maximum Plasticity Index: 15.

B. Provide imported material of equivalent quality, if required to accomplish Work.

2.04 GRANULAR FILL

A. No. 56 or No. 57 stone as specified in Section 801 of the Standard Specifications.

B. Clean, tough, uniform quality, durable fragments of crushed rock, free from flat, elongated, soft or disintegrated pieces, or other objectionable matter occurring either free or as coating on stone.

2.05 SAND

A. Free from clay, organic matter, or other deleterious material.

B. As per Standard Specification Section 802.

2.06 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.07 BASE COURSE

A. As specified in Section 32 11 23, Aggregate Base Course.

2.08 SOIL COVER OVER GEOTEXTILES

A. Particle Size: Maximum 1 inch.

B. Free of sharp angular pieces that may damage geotextile.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure even.

D. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

E. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 31 23 23.15, Trench Backfill.
4. Install item.
5. Backfill envelope zone and remaining trench, as specified in Section 31 23 23.15, Trench Backfill, before resuming filling or backfilling specified in this section.

F. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

G. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with structural fill, unless otherwise shown. Place structural fill in lifts of 6-inch maximum thickness and compact each lift to minimum of 98 percent relative compaction as determined in accordance with ASTM D698 Method.

B. Subsurface Drainage: Backfill with granular drain material, where shown. Place granular drain material in lifts of 8-inch maximum thickness and compact each lift to minimum of 90 percent relative density.

C. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 93 percent relative compaction as determined in accordance with ASTM D698.

3.03 FILL

A. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:

1. Allow for 6-inch thickness of topsoil where required.
2. Maximum 8-inch thick lifts.
3. Place and compact fill across full width of embankment.
4. Compact to minimum 93 percent relative compaction as determined in accordance with ASTM D698.
5. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.04 SITE TESTING

A. Gradation:

1. One sample from each 1,000 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests: In accordance with ASTM D6938. During placement of materials, test as follows:

1. Fill and Backfill Material: One test for every 2 feet of lift interval per 2,000 square feet.
2. Base Course: As Specified in Section 32 11 23, Aggregate Base Course.

3.05 SAND BLANKET OVER VAPOR RETARDER

A. Place sand in manner that avoids damage to underlying vapor retarder.

B. Moisten sand and thoroughly compact it with a vibratory plate compactor.

3.06 GRANULAR BASE, SUBBASE, AND SURFACING

A. Place and Compact as specified in Section 32 11 23, Aggregate Base Course.

3.07 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by Engineer as follows:

1. Beneath Footings: Structural fill.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Granular fill.
4. Trenches:
    a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 31 23 23.15, Trench Backfill.
    b. Authorized Overexcavation: Trench stabilization material, as specified in Section 31 23 23.15, Trench Backfill.
5. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
    a. Flat to Moderate Steep Slopes (3:1, Horizontal Run: Vertical Rise or Flatter): Earthfill.
    b. Steep Slopes (Steeper than 3:1):
        1) Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.
        2) Backfilling overexcavated areas is prohibited, unless in Engineer's opinion, backfill will remain stable, and overexcavated material is replaced as compacted earthfill.

3.08 PLACING FILL OVER GEOSYNTHETICS

A. General:

1. Place fill over geosynthetics with sufficient care so as not to damage them.
2. Place fill only by back dumping and spreading only.
3. Dump fill only on previously placed fill.
4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.

B. Hauling: Operate hauling equipment on minimum of 3 feet of covering.

C. Spreading:

1. Spreading equipment shall be track mounted low ground pressure, D-6 or lighter.
2. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
4. Never push fill downslope. Spread fill over side-slopes by pushing up from slope bottom. If access to bottom of slope is unavailable, progressively place fill, beginning at toe of slope and working upslope, with backhoe or dragline operated from top of slope. Limit distance material falls onto the geosynthetics in accordance with manufacturers recommendations.
5. Maintain proper overlap of unseamed geosynthetics.
6. Avoid overstressing geosynthetics and seams.

D. Compaction: Compact fill only after uniformly spread to full thickness shown.

E. Geosynthetic Damage:

1. Mark punctures, tears, or other damage to geosynthetics, so repairs may be made.
2. Clear overlying fill as necessary to repair damage.
3. Repairs to geosynthetics shall be made by respective installers as specified in respective specification section for each geosynthetic.

3.09 ACCESS ROAD SURFACING

A. Place and compact as specified in Section 32 11 23, Aggregate Base Course.

END OF SECTION

SECTION 31 23 23.15
TRENCH BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code.
2. ASTM International (ASTM):
   a. C33/C33M, Standard Specification for Concrete Aggregates.
   b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C150/C150M, Standard Specification for Portland Cement.
   f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   g. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   h. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   i. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75 micrometer) Sieve.
   j. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   k. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   l. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   m. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   n. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   o. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

p. D4991, Standard Test Method for Leakage Testing of Empty Rigid Containers by Vacuum Method.
q. D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).

3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

1.02 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.

H. Relative Density: As defined by ASTM D4253 and ASTM D4254.

I. Selected Backfill Material: Material available onsite that Engineer determines to be suitable for a specific use.

J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Satisfying both of the following requirements, as defined in ASTM D2487:

1. Coefficient of Curvature: Greater than or equal to 1 and less than or equal to 3.
2. Coefficient of Uniformity: Greater than or equal to 4 for materials classified as gravel, and greater than or equal to 6 for materials classified as sand.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer's descriptive literature for marking tapes and tracer wire.
2. Samples:
   a. Trench stabilization material.
   b. Bedding and pipe zone material.
   c. Granular drain.
   d. Granular backfill.
   e. Earth backfill.
   f. Sand(s).
   g. Geotextile.

B. Informational Submittals:

1. Catalog and manufacturer's data sheets for compaction equipment.
2. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
3. Controlled Low Strength Material: Certified mix design and test results. Include material types and weight per cubic yard for each component of mix.

PART 2 PRODUCTS

2.01 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 5 mils.
3. Width: 3 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Manufacturers and Products:
   a. Reef Industries; Terra Tape.
   b. Mutual Industries; Non-detectable Tape.
   c. Presco; Non-detectable Tape.

B. Color: In accordance with APWA Uniform Color Code.

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 TRENCH STABILIZATION MATERIAL

A. ALDOT No. 57 Stone if the depth of stabilization material required is less than 18 inches. Use ALDOT No. 2 Stone if the depth of the stabilization material required is equal to or larger than 18 inches.

2.03 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Unfrozen, friable, and no clay balls, roots, or other organic material.

2.04 EARTH BACKFILL

A. Soil, loam, or other excavated material suitable for use as backfill.

B. Free from roots or organic matter, refuse, boulders and material larger than 1/2 cubic foot, or other deleterious materials.

2.05 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Cement: ASTM C150/C150M, Type I or Type II.
2. Aggregate: ASTM C33/C33M, Size 7.
3. Fly Ash (Pozzolan): Class F [or Class C] fly ash in accordance with ASTM C618, except as modified herein:
   a. ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.06 CONCRETE BACKFILL

A. Provide as specified in Section 03 30 10, Structural Concrete.

2.07 GRAVEL SURFACING ROCK

A. As specified in Section 32 11 23, Aggregate Base Course.

2.08 TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

2.09 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earth backfill, including specified class.
2. Trench stabilization material.
3. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs:

1. Controlled low strength material.
2. Concrete.

PART 3 EXECUTION

3.01 TRENCH PREPARATION

A. Water Control:

1. Dewater excavation as needed in accordance with Section 31 23 19.01, Dewatering.
2. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water. As specified in Section 31 23 19.01, Dewatering.
3. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
4. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.02 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of overexcavation, if any required.

3.03 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.04 BEDDING

A. Furnish imported bedding material where, in the opinion of Engineer, excavated material is unsuitable for bedding or insufficient in quantity.

B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness: As follows:

1. Pipe 15 Inches and Smaller: 4 inches.
2. Pipe 18 Inches to 36 Inches: 6 inches.
3. Pipe 42 Inches and Larger: 8 inches.
4. Conduit: 3 inches.
5. Direct-Buried Cable: 3 inches.
6. Duct Banks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.05 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit: 3 inches, unless shown otherwise.
3. Direct-Buried Cable: 3 inches, unless shown otherwise.
4. Duct Bank: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

E. After full depth of pipe zone material has been placed as specified, compact material by a minimum of three passes with a vibratory plate compactor or motive sheepsfoot roller only over area between sides of pipe and trench walls. Take care to avoid damaging pipe and pipe coating.

3.06 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of buried piping, along centerline of buried piping, 1 foot above the top of pipe.

3.07 BACKFILL ABOVE PIPE ZONE

A. As specified in Section 31 23 23, Fill and Backfill.

3.08 REPLACEMENT OF TOPSOIL

A. Replace topsoil in top 6 inches of backfilled trench.

B. Maintain finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

3.09 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep surface of backfilled trench even with adjacent ground surface, and grade and compact as necessary to keep surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain surface of backfilled trench level with adjacent ground surface.

D. Asphaltic Pavement: Replace settled areas or fill with asphalt as shown in Drawings.

E. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.10 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C29, Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate.
   b. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   c. C117, Standard Method of Test for Materials Finer Than 75μm (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C131, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   e. C183, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   f. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).
   g. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3 (2700 kN-m/m^3)).
   h. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
   i. D2216, Standard Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
   j. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   k. D2844, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   l. D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
   m. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
   n. D5195, Standard Test Methods for Density of Soil and Rock In-Place Below Surface by Nuclear Methods.
   o. D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Standard Specifications: When referenced in this section, shall mean Latest Edition of the Alabama Department of Transportation Standard Specifications for Highway Construction.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples: Submit for specified materials 20 days prior to delivery to Site.

B. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 20 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.

PART 2 PRODUCTS

2.01 BASE COURSE

A. Type B crushed aggregate conforming to Section 825 of the Standard Specifications.

2.02 GRAVEL SURFACING

A. Type B crushed aggregate conforming to Section 825 of the Standard Specifications.

2.03 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

3.02 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.03 HAULING AND SPREADING

A. In accordance with applicable sections of Division 300 of the Standard Specifications.

B. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

C. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway or prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.04 CONSTRUCTION OF COURSES

A. Construction of Courses: In accordance with Section 301 of the Standard Specifications**.**

3.05 ROLLING AND COMPACTION

A. In accordance with Section 301 of the Standard Specifications, except as modified hereinafter.

B. Commence compaction of each layer of [base after spreading operations and continue until density of 100 percent of maximum density has been achieved as determined by ASTM D698.

3.06 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Gravel Surfacing: Within 0.04 foot from lower edge of 10-foot straightedge placed on finished surface, parallel to centerline.

C. Overall Average: Within plus or minus 0.01 foot from crown and grade specified.

3.07 FIELD QUALITY CONTROL

A. In-Place Density Tests: if requested by Engineer.

1. As specified in General Conditions.
2. Refer to Table 2 for minimum sampling and testing requirements for aggregate base course and surfacing.

Table 2
Minimum Sampling and Testing Requirements

Property	Test Method	Frequency	Sampling Point
Moisture Density (Maximum Density)	ASTM D698, Method D	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	ASTM D5195, ASTM D6938, and ASTM D2216 for moisture content	One for each 500 ton but at least every 10,000 sq ft of area	In-place completed, compacted area

3.08 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 GENERAL

1.01 REFERENCES

A. Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas, Volumes 1 and 2, latest edition.

1.02 DEFINITIONS

A. Maintenance Period: Begin maintenance immediately after each area is planted (seed, sod, or sprig) and continue for a period of 8 weeks after all planting under this section is completed.

B. Satisfactory Stand: Grass areas that have:

1. No bare spots larger than 3 square feet.
2. Not more than 10 percent of total area with bare spots larger than 1 square foot.
3. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.03 SUBMITTALS

A. Action Submittals: Product labels/data sheets.

B. Informational Submittals:

1. Seed: Certification of seed analysis, germination rate, and inoculation:
   a. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing, within 6 months of date of delivery. Include with certification:
      1) Name and address of laboratory.
      2) Date of test.
      3) Lot number for each seed specified.
      4) Test Results: (i) name, (ii) percentages of purity and of germination, and (iii) weed content for each kind of seed furnished.
   b. Mixtures: Proportions of each kind of seed.
2. Seed Inoculant Certification: Bacteria prepared specifically for legume species to be inoculated.
3. Certification of sod; include source and harvest date of sod, and sod seed mix.
4. Description of required maintenance activities and activity frequency.

1.04 DELIVERY, STORAGE, AND PROTECTION

A. Seed:

1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
2. Keep dry during storage.

B. Sod:

1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.
2. Harvest and deliver sod only after laying bed is prepared for sodding.
3. Roll or stack to prevent yellowing.
4. Deliver and lay within 24 hours of harvesting.
5. Keep moist and covered to protect from drying from time of harvesting until laid.

C. Sprigs:

1. Cut and deliver only after planting area is prepared for planting.
2. Deliver and plant within 24 hours of harvesting.
3. Keep moist and covered to protect from drying from time of cutting until planted.

D. Hydroseeding Mulch: Mark package of wood fiber mulch to show air dry weight.

1.05 WEATHER RESTRICTIONS

A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.06 SEQUENCING AND SCHEDULING

A. Complete Work and prepare topsoil as specified in Section 32 91 13, Soil Preparation, before starting Work of this section.

B. Complete Work under this section within 10 days following completion of soil preparation.

C. Notify Engineer at least 3 days in advance of:

1. Each material delivery.
2. Start of planting activity.

D. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice.

1.07 MAINTENANCE SERVICE

A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.
2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.
3. Mulch: Replace wherever and whenever washed or blown away.
4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.
5. Fence: Repair and maintain until satisfactory stand of grass is established.
6. Place solid sod immediately at the end of the maintenance period if a satisfactory stand has not been produced.
7. Reseed/replant during next planting season if scheduled end of maintenance period falls after September 15.
8. Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

PART 2 PRODUCTS

2.01 FERTILIZER

A. As specified in Section 32 91 13, Soil Preparation.

2.02 SEED

A. Fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.

B. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer's instructions.

C. Summer Seed Mix for Areas: As Specified in Section 860 of the Standard Specifications Winter Protective Seed: As Specified in Section 860 of the Standard specifications.

2.03 SOD

A. Certified, containing grass mix: As Specified in Section 654 of the Standard Specifications.

B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.

1. Grass Height: 1-1/2 to 2-1/2 inches.
2. Strip Size: 16 inches wide and at least 3 feet long.
3. Soil Thickness: Uniform; 1 inch plus or minus 1/4 inch at time of cutting.
4. Age: Not less than 10 months or more than 30 months.
5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted.

2.04 STRAW MULCH

A. Threshed straw of oats, wheat, barely, or rye, free from (i) seed of noxious weeds or (ii) clean salt hay.

2.05 HYDROSEEDING MULCH

A. Wood Cellulose Fiber Mulch:

1. Specially process wood fiber containing no growth or germination inhibiting factors.
2. Dyed a suitable color to facilitate inspection of material placement.
3. Manufactured such that after addition and agitation in slurry tanks with water, the material fibers will become uniformly suspended to form homogenous slurry.
4. When hydraulically sprayed on ground, material will allow absorption and percolation of moisture.

PART 3 EXECUTION

3.01 PREPARATION

A. Grade areas to smooth, even surface with loose, uniformly fine texture.

1. Roll and rake, remove ridges, fill depressions to meet finish grades.
2. Limit such Work to areas to be planted within immediate future.
3. Remove debris, and stones larger than 1-1/2-inch diameter, and other objects that may interfere with planting and maintenance operations.

B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.

C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

3.02 FERTILIZER

A. Do not apply fertilizer to areas identified as Jurisdictional Waters of US (Wetlands), generally areas north of Vaughn Road.

B. As specified in Section 32 91 13, Soil Preparation.

C. Application Rate: Determined by soil test results performed by county or state soil testing service or approved certified independent testing laboratory.

3.03 SEEDING

A. Start within 2 days of preparation completion.

B. Hydroseed slopes steeper than 3H:1V. Flatter slopes may be mechanically seeded.

C. Mechanical: Broadcast seed in two different directions, compact seeded area with cultipacter or roller.

1. Sow seed at uniform rate as specified in Section 665 of the Standard Specifications.
2. Use Brillion type seeder.
3. Broadcasting will be allowed only in areas too small to use Brillion type seeder. Where seed is broadcast, increase seeding rate 20 percent.
4. Roll with ring roller to cover seed, and water with fine spray.

D. Hydroseeding:

1. Application Rate: As specified in Section 652 and 860 of the Standard Specifications.
2. Apply on moist soil, only after free surface water has drained away.
3. Prevent drift and displacement of mixture into other areas.
4. Upon application, allow absorption and percolation of moisture into ground.
5. Mixtures: Seed and fertilizer may be mixed together, apply within 30 minutes of mixing to prevent fertilizer from burning seed.

E. Cover Crop Seeding: Apply seed at rate of 120 pounds per acre to areas that are bare or incomplete after normal planting season.

F. Mulching: Apply uniform cover of straw mulch at a rate of 2 tons per acre. Do not apply mulch to areas delineated as Waters of the US (Wetlands), generally areas north of Vaughn Road.

G. Netting: Immediately after mulching, place over mulched areas with slopes steeper than 3:1, in accordance with manufacturer's instructions. Locate strips parallel to slope and completely cover seeded areas.

H. Water: Apply with fine spray to saturate top 4 inches of soil.

3.04 SODDING

A. Do not plant dormant sod, or when ground is frozen.

B. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap.

1. Stagger strips to offset joints in adjacent courses.
2. Work from boards to avoid damage to subgrade or sod.
3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.
4. Complete sod surface true to finished grade, even, and firm.

C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.

D. Water sod with fine spray immediately after planting. During first week, water daily or more frequently to maintain moist soil to depth of 4 inches.

E. Apply top dress fertilizer at recommended rate if not already performed by harvesting farm.

3.05 FIELD QUALITY CONTROL

A. 8 weeks after seeding is complete and on written notice from Contractor, Engineer will, within 15 days of receipt, determine if a satisfactory stand has been established.

B. If a satisfactory stand has not been established, Engineer will make another determination after written notice from Contractor following the next growing season.

END OF SECTION

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
3. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
   c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. International Code Council (ICC):
5. International Building Code (IBC).
6. International Mechanical Code (IMC).
7. Manufacturers' Standardization Society (MSS):
   a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
   b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.02 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.03 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping 16 inches and smaller. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment and anchor.

3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Maintenance information on piping support system.

1.04 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes.
3. Wind loads in accordance with governing codes.
4. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
   a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
   b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.
5. Electrical Conduit Support: Include in design of framing support system.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support. Reference Section 01 88 15, Anchorage and Bracing for additional information and requirements.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: In accordance with Table 1 and Table 2, attached as Supplements at end of section.

2.02 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Saddle Supports, Pedestal Type:

1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
2. Nonadjustable Saddle: MSS SP , Type 37 with U-bolt.
   a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
   b. B-Line; Figure B3095, sizes 1 inch through 36 inches with B3088S base.
3. Adjustable Saddle: MSS SP 58, Type 38 without clamp.
   a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
   b. B-Line; Figure B3092, sizes 3/4 inch through 36 inches with Figure B3088S base.

2.03 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel.

B. Members and Connections: Design for loads using one-half of manufacturer’s allowable loads.

C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.

D. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).
5. Enduro-Durostrut (FRP Systems).

2.04 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.

1. Anvil; Figure 40, sizes 3/4 inch through 24 inches.

2.05 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.06 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.

1. Manufacturer and Product: B-Line; Figure B3552, 1-1/2 inches through 30 inches.

B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.

1. Anvil; Figure 137 and Figure 137S.
2. B-Line; Figure B3188 and Figure B3188NS.

2.07 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:

1. Anvil; Figure 255, sizes 1/2 inch through 24 inches.
2. B-Line; Figure B3281 through Figure B3287, sizes 1/2 inch through 24 inches.

2.08 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.09 SEISMIC RESTRAINTS

A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.

B. Manufacturers:

1. Mason Industries.
2. B-Line.
3. Anvil.

2.10 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.
2. Bolt Length (Extension Above Top of Nut):
   a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
   b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer and Products:
   a. B-Line; B1999 Vibra Cushion.
   b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers and Products:
   a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
   b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Welding Insulation Saddles:

1. Type: MSS SP 58, Type 39.
2. Manufacturers and Products:
   a. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
   b. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

E. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.

F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

G. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP 58, Type 22.
   a. Anvil; Figure 66.
   b. B-Line; Figure B3083.
4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
5. Concrete Attachment Plates:
   a. Anvil; Figure 47, Figure 49, or Figure 52.
   b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.

10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
   b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
   b. Stacked Piping: Wall mounted framing system and "J" hangers acceptable for pipe smaller than 3-inch.
   c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
   a. Saddle Supports:
      1) Pedestal Type, elbow and flange.
      2) Provide minimum 1-1/2-inch grout beneath baseplate.
   b. Floor Mounted Channel Supports:
      1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
      2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
      3) Attach pipe to channel with clips or pipe clamps.
   c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
4. Insulated Pipe:
   a. Pipe hanger and support shall be on outside of insulation. Do not enclose within insulation.
   b. Provide precut 120-degree sections of rigid insulation (minimum length same as shield), shields and oversized hangers or insulated saddle system (ISS).
   c. Wall-mounted pipe clips not acceptable for insulated piping.
5. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
   a. Single point attachment to ceiling is allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).
   b. Where there is vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
2. Steel Beams: I-beam clamp or welded attachments.
3. Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
4. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
5. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Saddles for Steel or Concrete Pipe: Provide 90-degree to120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.

E. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

F. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.
3. Dielectric Barrier:
   a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
   b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

3.03 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this specification:

1. Table 1: Nonchemical Areas.

END OF SECTION

Table 1
Nonchemical Areas

Exposure Conditions	Support Material
Electrical Buildings	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Headworks, Outdoors, All Other Dry Process Areas	Stainless steel
Process Areas: High Humidity or Hydrogen sulfide	Stainless steel
Process Areas: Wetted or Submerged	Stainless steel

Notes:

1. Precoated steel to be fusion bonded epoxy or vinyl copolymer (Plastisol).
2. Stainless steel to be Type 304.
3. Galvanized steel to be per ASTM A653/A653M, Class G90, or hot-dip galvanized after fabrication to ASTM A123/A123M.
4. Do not use galvanized steel or aluminum where lime dust can accumulate on these surfaces.

SECTION 40 05 33
PIPE HEAT TRACING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Factory Mutual.
2. Institute of Electrical and Electronics Engineers, Inc (IEEE): 515, Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.
3. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
4. Underwriters Laboratories, Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's descriptive literature.
2. Plastic Pipe Installations: Output adjustment factors for heating tape for the services indicated.
3. Pipe heat loss calculations for each pipe size to be heat traced.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN REQUIREMENTS

A. Design Heating Load:

1. Heating load to be calculated based upon a 50 degree F delta, 20 mph wind if pipes are located outdoors, insulation as specified in Section 40 42 13, Process Piping Insulation, pipe as specified in Section 40 27 00, Process Piping—General, and shall include a 10 percent safety factor.
2. Heat loss calculations shall be based on IEEE 515, Equation 1, Page 19.

2.02 ELECTRICAL HEATING TAPE

A. Cable: Self-limiting, parallel circuit construction consisting of continuous inner core of variable resistance conductive heating material between two parallel copper bus wires. Provide tinned copper braid for PVC, FRP, and stainless steel pipe applications.

B. UL Listing: Listed as self-limiting pipe tracing material for pipe freeze protection application in ordinary conditions.

C. Maximum Maintenance Temperature: 150 degrees F (65 degrees C).

D. Maximum Intermittent Temperature: 185 degrees F (85 degrees C).

E. Service Voltage: As indicated by branch circuits provided for heat tracing on the Drawings.

F. Manufacturers and Products:

1. Raychem; BTV-CR.
2. Thermon; BSX.
3. Nelson; CL1-J1 or L1-J1.

2.03 CONNECTION SYSTEM

A. Rating: NEMA 250, Type 4 and Factory Mutual approved.

B. Operating Monitor Light: Furnish with each circuit power connection kit to indicate when heat tracing is energized.

C. Manufacturers and Products:

1. Power Connection Kit:
   a. Raychem; JBS-100.
   b. Thermon; PCA-1-SR or DP-L.
   c. Nelson; PLT-BC.
2. Splice Kit:
   a. Raychem; S-150.
   b. Thermon; PCS-1-SR.
   c. Nelson; PLT-BS.
3. Tee Kit:
   a. Raychem; T-100.
   b. Thermon; DS-S.
   c. Nelson; PLT-BY.

4. End Seal Kit:
    a. Raychem; E-150.
    b. Thermon; DE-S.
    c. Nelson; LT-ME.
5. Lighted End Seal Kit:
    a. Raychem; E-100-L.
    b. Thermon; DLS.
    c. Nelson; LT-L.

2.04 SECURING TAPE

A. Plastic Piping Systems:

1. Type: Aluminum foil coated adhesive tape.
2. Manufacturers and Products:
    a. Raychem; AT-180.
    b. Thermon; AL-20P.
    c. Nelson; AT-50.

B. Metallic Piping Systems:

1. Type: Glass or polyester cloth pressure sensitive tape.
2. Manufacturers and Products:
    a. Raychem; GS54 or GT66.
    b. Thermon; PF-1.
    c. Nelson; GT-6 or GT-60.

2.05 PIPE MOUNTED THERMOSTAT

A. Type: Fixed, nonadjustable, set at 40 degrees F.

B. Sensor: Fluid-filled with 3-foot capillary.

C. Enclosure: Glass-filled nylon, NEMA 250, Type 4X weatherproof with gasketed lid.

D. Switch: SP-ST, UL listed, rated 22 amps, 120 to 240V ac.

E. Manufacturers and Products:

1. Raychem; DigiTrace Model AMC-F5.
2. Thermon; E4X-1.
3. Raychem; DigiTrace Model E507S-LS for hazardous areas.
4. Thermon; E7-25325 for hazardous areas.

2.06 AMBIENT THERMOSTAT

A. Type: Adjustable setting (15 to 140 degrees F).

B. Sensor: Fluid-filled probe.

C. Enclosure: Epoxy-coated NEMA 250, Type 4X aluminum enclosure with exposed hardware of stainless steel.

D. Switch: SP-DT, UL or FM listed, rated 22 amps, 125 to 250V ac.

E. Manufacturers and Products:

1. Raychem; DigiTrace Model AMC-1A.
2. Thermon; B4X-15140.
3. Raychem; DigiTrace Model AMC-1H for hazardous areas.
4. Thermon; B7-15140 for hazardous areas.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install in accordance with the manufacturer's instructions and recommended practices.
2. Provide insulation as specified in Section 40 42 13, Process Piping Insulation, over all pipe heat tracing.
3. Ground metallic structures or materials used for support of heating cable or on which it is installed in accordance with applicable codes.
4. Wiring between power connection points of heat tracing cable branch lines shall be provided by heat tracing system supplier.
5. Provide end of circuit pilot lights on heat tracing circuits for buried piping.

B. Electrical Heating Tape:

1. Determine required length of electrical heating tape by considering length of circuit, number and type of fittings and fixtures, design heating load, and heating tape output.
2. Where design heating load exceeds heating tape capacity, install by spiraling.
3. Derate heating tape capacity when installed on plastic piping.

4. Install on services as follows:

Facility	Service	Piping Material	Enclosure Type	Notes
12 – Temporary Preliminary Treatment Facility	W3	See Specification 40 42 13 for Piping Schedule	Suitable for Class I, Div. 2 Locations	Install on outdoors, exposed piping 1.5" or smaller. Outdoor, corrosive, wet location.

5. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:

Item	Heating Tape Length (min. feet)
Bolted flanges (per pair)	Two times pipe diameter
Valves	Four times valve length
Pipe hanger or support penetrating insulation	Three times pipe diameter

C. Heat Tracing Circuits: Limit individual lengths of heat tracing circuits such that maximum single circuit capacity is 20 amps when starting the circuit at 40 degrees F. Provide multiple 20-amp circuits as required at individual heat tracing locations.

D. Thermostats:

1. Install in accordance with manufacturer's instructions and as approved by Engineer.
2. For each group of heat traced circuit, install one ambient thermostat.

3.02 FIELD QUALITY CONTROL

A. Test each circuit with 500-volt insulation tester between circuit and ground with neutrals isolated from ground.

1. Insulation Resistance: Minimum 1,000 megohms per 1,000 feet.

END OF SECTION

SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. Air Force: A-A-58092, Tape, Antiseize, Polytetrafluorethylene.
2. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges.
3. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
4. American Society of Mechanical Engineers (ASME):
   a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
   b. B1.20.1, Pipe Threads, General Purpose (Inch).
   c. B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
   d. B16.3, Malleable Iron Threaded Fittings Classes 150 and 300.
   e. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
   f. B16.9, Factory-Made Wrought Buttwelding Fittings.
   g. B16.11, Forged Fittings, Socket-Welding and Threaded.
   h. B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
   i. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   j. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   k. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 600, 900, 1500, and 2500.
   l. B16.25, Buttwelding Ends.
   m. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
   n. B31.1, Power Piping.
   o. B31.3, Process Piping.
   p. B31.9, Building Services Piping.
   q. B36.10M, Welded and Seamless Wrought Steel Pipe.
5. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Recommended Practice for Personal Qualification and Certification in Nondestructive Testing.

6. American Water Works Association (AWWA):
    a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
    b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
    c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
    d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    f. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast.
    g. C153/A21.53, Ductile-Iron Compact Fittings.
    h. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
    i. C606, Grooved and Shouldered Joints.
7. American Welding Society (AWS):
    a. Brazing Handbook.
    b. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
    c. D1.1/D1.1M, Structural Welding Code - Steel.
    d. QC1, Standard for AWS Certification of Welding Inspectors.
8. ASTM International (ASTM):
    a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
    b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
    d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
    e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    f. A135/A135M, Standard Specification for Electric-Resistance-Welder Steel Pipe.
    g. A139/A139M, Standard Specification for Electro-Fusion (Arc)–Welded Steel Pipe (NPS 4 Inches and Over).
    h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
    j. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
    k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.

l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
n. A197/A197M, Standard Specification for Cupola Malleable Iron.
o. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
q. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
r. A276, Standard Specification for Stainless Steel Bars and Shapes.
s. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
t. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
u. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
v. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
w. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
x. A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
y. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
z. A409/A409M, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
aa. A536, Standard Specification for Ductile Iron Castings.
bb. A563, Standard Specification for Carbon and Alloy Steel Nuts.
cc. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
dd. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
ee. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
ff. A774/A774M, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

gg. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
hh. B32, Standard Specification for Solder Metal.
ii. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
jj. B61, Standard Specification for Steam or Valve Bronze Castings.
kk. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
ll. B75/B75M, Standard Specification for Seamless Copper Tube.
mm. B88, Standard Specification for Seamless Copper Water Tube.
nn. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
oo. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
pp. B464, Standard Specification for Welded UNS N08020 Alloy Pipe.
qq. B474, Standard Specification for Electric Fusion Welded Nickel and Nickel Alloy Pipe.
rr. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
ss. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
tt. D413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.
uu. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
vv. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
ww. D1330, Standard Specification for Rubber Sheet Gaskets.
xx. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
yy. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
zz. D2000, Standard Classification System for Rubber Products in Automotive Applications.

aaa. D2310, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
bbb. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ccc. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ddd. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
eee. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
fff. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
ggg. D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
hhh. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
iii. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
jjj. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
kkk. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
lll. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
mmm. F423, Standard Specification for Polytetrafluoroethylene (PTFE) Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges.
nnn. F436, Standard Specification for Hardened Steel Washers.
ooo. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
ppp. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
qqq. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
rrr. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
sss. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ttt. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

9. FM Global (FM).
10. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications.
11. NSF International (NSF): 61 Drinking Water System Components—Health Effects.
12. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
13. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.02 DEFINITIONS

A. Submerged or Wetted: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall roof surface or water holding structure, open or covered.

1.03 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. Boiler and Steam Piping: ASME B31.1.
2. Process Piping: ASME B31.3, normal fluid service unless otherwise specified.
3. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
4. Thrust Restraints:
    a. Design for test pressure shown in Piping Schedule.
    b. Allowable Soil Pressure: 1,000 pounds per square foot.
    c. Low Pressure Pipelines:
        1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.
        2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Fabricated Piping:
   a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
   b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
   c. Where tying into existing piping do not submit piping layout drawings without completion of field location activities including exposing piping to discover pipe material, diameter, location, and top of pipe elevation.
2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
3. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
4. Pipe Corrosion Protection: Product data.
5. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Certification of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
   a. Pipe and fittings.
   b. Factory applied resins and coatings.
2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torquing requirements and bolt tightening procedures.
4. Qualifications:
   a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
   b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
   c. Welders: Welder qualification test records conducted by Contractor or manufacturer.
5. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Test logs.

C. Piping Tie-Ins:

1. All existing piping tie-in points shall be field located and exposed to verify location and elevation as described herein.
2. All pipe tie-ins shall be restrained. Submit pipe restraint calculations per Section 1.03.A.4.
3. Provide coordination plan to Engineer and Owner a minimum of 7 calendar days before planned tie-in activities including:
   a. Planned down time for any effect facilities.
   b. Pipe layout per Section 1.04.A
   c. Anticipated difficulties and proposed resolutions
   d. Excavation plan including protection and support of existing facilities or piping.
   e. Pipe Restraint design, signed and sealed by Professional Engineer in the State of Alabama.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Independent Inspection and Testing Agency:
   a. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
   b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
   c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
   d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.
   e. Verification Welding Inspector: AWS QC1 Certified.
2. Welding Procedures: In accordance with ASME BPVC SEC IX (Forms QW-482 and QW-483) or AWS D1.1/D1.1M (Annex N Forms).
3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).
4. Contractor's CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.

3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 PIPING

A. As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
3. Cement-Lined Steel Pipe: Lining inside diameter.

2.02 JOINTS

A. Rigid type.

B. Use of flexible grooved joints allowed where shown on Drawings or with prior approval by Engineer.

C. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

D. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

E. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

F. Mechanical Joint Anchor Gland Follower:

1. Ductile iron anchor type, wedge action, with break-off tightening bolts.
2. Thrust rated to 250 psi minimum.
3. Rated operating deflection not less than:
   a. 3 degrees for sizes through 12 inches.
   b. 2 degrees for sizes 14 inches through 16 inches.

c. 1.5 degrees for sizes 18 inches through 24 inches.
d. 1 degree for sizes 30 inches through 48 inches.

4. UL and FM approved.

G. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
   a. Pipeline Products Corp.
   b. Fernco Joint Sealer Co.

H. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through-flanged connections consisting of the following:

1. Polyethylene stub end thermally butt-fused to end of pipe.
2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Use insulating flanges where shown.
3. Bolts and nuts of sufficient length to show a minimum of three complete threads when joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
4. Gaskets as specified on Data Sheet.

2.03 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

2.04 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 90 00, Painting and Coating, for details of coating requirements.

B. Polyethylene Encasement (Bagging):

1. Encasement Tube: Black polyethylene encasement tube, 8 mils minimum thickness, conforming to AWWA C105/A21.5, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.
2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.
3. Manufacturer: V-Bio Enhanced Polyethylene Encasement.

C. Insulating Flanges, Couplings, and Unions:

1. Materials:
   a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.9 working pressure rating equal to or higher than that of joint and pipeline.
   b. Galvanically compatible with piping.
   c. Resistant for intended exposure, operating temperatures, and products in pipeline.
2. Union Type, 2 Inches and Smaller:
   a. Screwed or solder-joint.
   b. O-ring sealed with molded and bonded insulation to body.
3. Flange Type, 2-1/2 Inches and Larger:
   a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
   b. Bolt insulating sleeves shall be provided full length between insulating washers.
   c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.
   d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.
   e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.
4. Flange Insulating Kits:
   a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
   b. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).
   c. Insulating Washers: High-strength phenolic.
      1) Flange Diameters 36 Inches or Less: Provide two washers per bolt.
      2) Flange Diameters Larger Than 36 Inches: Provide four washers per bolt.
5. Manufacturers and Products:
   a. Dielectric Flanges and Unions:
      1) PSI, Houston, TX.
      2) Advance Products and Systems, Lafayette, LA.
   b. Insulating Couplings:
      1) Dresser; STAB-39.
      2) Baker Coupling Company, Inc.; Series 216.

2.05 THRUST TIES

A. Steel Pipe: Fabricated lugs and rods in accordance with details shown on Drawings or joint harness as specified in Section 40 27 01, Process Piping Specialties.

B. Buried Ductile Iron Pipe and Fittings: Unless restraint is otherwise specified or shown, conform to NFPA 24. Tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.06 VENT AND DRAIN VALVES

A. Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

B. Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.07 FABRICATION

A. Mark each pipe length on outside with the following:

1. Size or diameter and class.
2. Manufacturer's identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

2.08 FINISHES

A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.02 PREPARATION

A. See Piping Schedule and Section 09 90 00, Painting and Coating, for additional requirements.

B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.03 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.1 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting manufacturer.

B. Weld Identification: Keep paper record of which welder welded each joint.

C. Pipe End Preparation:

1. Machine Shaping: Preferred.
2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
3. Beveled Ends for Butt Welding: ASME B16.25.

D. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

F. Climatic Conditions: Do not perform welding if there is impingement of any rain, snow, sleet, or wind exceeding 5 mph on the weld area, or if ambient temperature is below 32 degrees F.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Quality: Meet requirements of governing welding codes.

3.04 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
8. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
10. Manufacturer: Same as pipe manufacturer or grooved joint flange adapter manufacturer.

D. Threaded and Coupled Joints:

1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Grooved-End Joints:

1. Piping shall be grooved in accordance with manufacturer's latest published instructions and shall be accurately cut with tools conforming to coupling manufacturer's standards and to AWWA C606.
2. Install grooved joint couplings and gaskets in accordance with manufacturer's latest published installation instructions.

F. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

G. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions in Section 40 27 01, Process Piping Specialties.

H. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Provide union type joints as shown on Drawings or in pipe runs longer than 40 feet.
3. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
4. Do not thread Schedule 40 pipe.

I. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive blade cutter. Do not flame cut.
2. Dressing Cut Ends:
   a. General: As required for the type of joint to be made.
   b. Rubber Gasketed Joints: Remove sharp edges or projections.
   c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
   d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

J. PVDF Lined Steel Pipe Installation:

1. Cut, make up, and install pipe in accordance with pipe manufacturer's written instructions.
2. Weld vent extension half couplings in place prior to lining pipe.
3. Do not weld on pipe after lining is installed
4. Prevent plugging of vent extensions with insulation or paint.

K. High-Density Polyethylene Piping:

1. Join pipes, fittings, and flange connections by means of thermal butt-fusion.
2. Perform butt-fusion in accordance with pipe manufacturer's recommendations as to equipment and technique.
3. Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.

3.05 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 3 inches from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.06 INSTALLATION—BURIED PIPE

A. Joints:

1. Dissimilar Buried Pipes:
   a. Provide flexible mechanical compression joints for pressure pipe.
   b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown.
2. Concrete Encased or Embedded Pipe: Do not encase joints in concrete, unless specifically shown.

B. Placement:

1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone: As specified in Section 31 23 23.15, Trench Backfill.
3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.
5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in direction of laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC, CPVC, or HDPE Pipe Placement:

1. Lay pipe snaking from one side of trench to other.
2. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:

1. Deflection from Horizontal Line , Except PVC, CPVC, or HDPE: Maximum 2 inches.
2. Deflection From Vertical Grade: Maximum 1/4 inch.
3. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.

4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.
5. Pipe Cover: Minimum 3 feet, unless otherwise shown.

3.07 INSTALLATION—CONCRETE ENCASED

A. Provide reinforced concrete pipe encasement where shown on Drawings and where otherwise required. Some piping may be required to be concrete encased for pipe strength requirements that are included in the Specifications. Piping under and within the influence of buildings, utility trenches, vaults, slabs, and other structures shall be concrete encased. See details on Drawings for encasement requirements.

B. Where concrete encased piping crosses structure construction and expansion joints, provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.08 PIPE CORROSION PROTECTION

A. Ductile Iron Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating, and as shown in Piping Schedule.
2. Buried: Wrap with polyethylene bagging.
3. Submerged or Embedded: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating. If in potable water service, use NSF 61 approved epoxy.

B. Carbon Steel Pipe:

1. Exposed: As specified in Section 09 90 00, Painting and Coating.
2. Buried:
   a. Pipe: Wrap with tape coating system as specified in Section 09 90 00, Painting and Coating.
   b. Joints: Wrap with tape coating system as specified in Section 09 90 00, Painting and Coating, or heat shrink wrap as specified herein.
3. Submerged or Embedded: Shop coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating. If in potable water service, use NSF 61 approved epoxy.

C. PVC and CPVC Pipe, Exposed: As specified in Section 09 90 00, Painting and Coating.

D. Piping Accessories:

1. Exposed:
   a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 90 00, Painting and Coating, as applicable to base metal material.
   b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
2. Buried:
   a. Ferrous Metal and Stainless Steel Components: Coat with coal-tar epoxy as specified in Section 09 90 00, Painting and Coating.
   b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
   c. Flexible Couplings and Similar Items: Wrap with heat shrink wrap.
   d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint matching coating applied to pipe and wrap entire valve in polyethylene encasement.

E. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.

F. Tape Coating System: As specified in Section 09 90 00, Painting and Coating.

G. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

H. Insulating Flanges, Couplings, and Unions:

1. Applications:
   a. Dissimilar metal piping connections.
   b. Submerged to unsubmerged metallic piping connections.
   c. Connections to existing metallic pipe.
   d. Where required for electrically insulated connection.
2. Pipe Installation:
   a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
   b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
   c. Align and install insulating joints as shown on the Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

3.09 THRUST RESTRAINT

A. Location:

1. Buried Piping: Where shown and where required to restrain force developed at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist because of hydrostatic testing and normal operating pressure.
2. Exposed Piping: At all joints in piping.

B. Thrust Ties:

1. Steel Pipe: Attach with lugs fabricated in accordance with details shown on Drawings or joint harness specified in Section 40 27 01, Process Piping Specialties.
2. Ductile Iron Pipe: Attach with socket clamps anchored against grooved joint coupling or flange.
3. Flanged Coupling Adapters: For exposed installations, install manufacturer's anchor studs through coupling sleeve or use dismantling joints.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping: Install pipe joint manufacturer's adapter gland follower and pipe end retainer, or mechanical joint anchor gland follower.

D. Thrust Blocking:

1. Place between undisturbed ground and fitting to be anchored.
2. Quantity of Concrete: Sufficient to cover bearing area on pipe and provide required soil bearing area as shown.
3. Place blocking so that pipe and fitting joints will be accessible for repairs.
4. Place concrete in accordance with Section 03 30 10, Structural Concrete.

3.10 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

3.11 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.12 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines as shown at all low and high point locations.

3.13 INSULATION

A. See Section 40 42 13, Process Piping Insulation.

3.14 HEAT TRACING

A. See Section 40 05 33, Pipe Heat Tracing.

3.15 FIELD FINISHING

A. Notify Engineer at least 3 days prior to start of surface preparation or coating application work.

B. As specified in Section 09 90 00, Painting and Coating.

3.16 PIPE IDENTIFICATION

A. Exposed: As specified in Section 09 90 00, Painting and Coating.

B. Buried: As specified in Section 31 23 23.15, Trench Backfill.

3.17 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

B. Minimum Duties of Welding Inspector:

1. Job material verification and storage.
2. Qualification of welders.
3. Certify conformance with approved welding procedures.
4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to Engineer of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:

1. Perform examinations in accordance with Piping Code ASME B31.1.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

3.18 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. Blow clean of loose debris plant process air, natural gas, and instrument air lines with compressed air at 4,000 fpm; do not flush with water.

C. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

D. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

E. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.19 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Piping Schedule.
2. Data Sheets.

Number	Title
40 27 00.01	Ceramic-Epoxy Lined Ductile Iron Pipe and Fittings
40 27 00.06	PVDF-Lined Steel Pipe and Ductile Iron Fittings
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40 27 00.14	High Density Polyethylene (HDPE) Pipe

END OF SECTION

MILLEY'S CREEK SCREEN REPLACEMENT
PIPING SCHEDULE

Service	Legend	Size(s) (in.) (Note 2)	Installation (Note 4)	Material (Note 3)	Specification Section	Joint Type (Note 5)	Lining/Coating (Note 6)	Test Pressure and Type (Note 7)	Remarks
Bypass	BYP								Use primary service for info.
Drain (Process)	DR								Use primary service for info.
Plant Drain Discharge	PDD	ALL	EMB, EXP, SUB	CELDI	40 27 00.01	FL	Ceramic Epoxy-Lined/No. 4	30, H	Coat EXP No. 4., EMB No. 7, and SUB end No. 2.
			BUR			MJ, PRJ	Ceramic Epoxy-Lined/Poly Encase		
Raw Sewage	RS	>= 4	EXP, SUB, EMB	CELDI	40 27 00.01	FL	Ceramic Epoxy-Lined/Remarks	30, H	Coat EXP No. 4., EMB No. 7, and SUB end No. 2.
			BUR			MJ, PRJ	Ceramic Epoxy-Lined/Poly Encase		
Screened Raw Sewage	SRS	ALL	EXP, SUB, EMB	CELDI	40 21 00.01	FL	Ceramic Epoxy-Lined/Remarks	30, H	Coat EXP No. 4., EMB No. 7, and SUB end No. 2.
			BUR			MJ, PRJ	Ceramic Epoxy-Lined/Poly Encase		
Sample	SA	ALL	ALL	PVC	40 27 00.10	W	Bare/No. 25	20, H	

MILLEY'S CREEK SCREEN REPLACEMENT
PIPING SCHEDULE

Service	Legend	Size(s) (in.) (Note 2)	Installation (Note 4)	Material (Note 3)	Specification Section	Joint Type (Note 5)	Lining/Coating (Note 6)	Test Pressure and Type (Note 7)	Remarks
No. 3 Water	W3	<=3	EXP, SUB, EMB	PVC	40 27 00.10	W	Bare/No. 5	150, H	Remark 3 Coat EMB No. 7, EXP No. 4, SUB No. 2
			BUR			S, W	None		
		>= 4	EXP, SUB, EMB	CELDI	40 27 00.01	FL	Ceramic Epoxy-Lined/Remarks		
			BUR			MJ, PRJ			

Notes:

1. Where piping carries two or more service designations the piping material shall conform to the requirement for the first service listed, e.g. CGW/OF would require the material used for CGW piping.

2. ">" Greater Than
   "<" Less Than
   "<=" Less Than or Equal To
   ">=" Greater Than or Equal To
   "All" All sizes

3. CELDI: Ceramic-Epoxy Lined Ductile Iron
   HDPE: High Density Polyethylene
   PSTL: PVDF-Lined Steel
   PVC: Polyvinyl Chloride
   PVDF: Polyvinylidene Fluoride

MILLEY'S CREEK SCREEN REPLACEMENT
PIPING SCHEDULE

Service	Legend	Size(s) (in.) (Note 2)	Installation (Note 4)	Material (Note 3)	Specification Section	Joint Type (Note 5)	Lining/Coating (Note 6)	Test Pressure and Type (Note 7)	Remarks

4. Installations

EXP: Exposed (interior or exterior)

BUR: Buried

EMB: Embedded (in concrete)

SUB: Submerged

ALL: All installations

5. Joints as specified in Section 40 27 00, Process Piping - General and in the sections referenced

FL – Flanged

PRJ - Proprietary Restrained Joint

S – Screwed

W – Welded

MJ – Mechanical Joint

RM – Mechanical Joint, Restrained

6. Coating system number as specified in Section 09 90 00, Painting and Coating, and as specified in Article, Pipe Corrosion Protection

Poly: Polyethylene wrap per Section 40 27 00

Tape: Tape wrap per Section 40 27 00

7. H: Hydrostatic Test

P: Pneumatic Test

G: Gravity Pipe - Test pressure is not shown on gravity pipes. Test to highest liquid level that pipe can be subject to.

MILLEY'S CREEK SCREEN REPLACEMENT
PIPING SCHEDULE

Service	Legend	Size(s) (in.) (Note 2)	Installation (Note 4)	Material (Note 3)	Specification Section	Joint Type (Note 5)	Lining/Coating (Note 6)	Test Pressure and Type (Note 7)	Remarks
PC: Test per Uniform Plumbing Code PSIG: Gauge Pressure, in units of pounds per square inch WSL: Water Surface Level									
Remarks: Heat trace as specified in Section 40 05 33.									

SECTION 40 27 00.01 CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
General	Materials in contact with potable water shall conform to NSF 61 acceptance. Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA C151/A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).
Pipe	Buried Liquid Service Using Push-on, Mechanical or Proprietary Restrained Joints: AWWA C111/A21.11, and AWWA C151/A21.51, pressure class conforming to Table 5 and Table 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Cement-mortar: AWWA C104/A21.4. Ceramic Epoxy: Pipe and fittings to be ceramic-epoxy lined shall not have been previously lined. Surface preparation shall be made to surfaces free of grease, oil, or other substance with abrasive blasting using clean sand or grit abrasive. Lining shall be done within 8 hours of surface preparation and surfaces shall be reblasted if rusting appears before lining. Line with a total dry film thickness of 40 mils of ceramic epoxy. Ceramic epoxy shall be amine-cured Novolac epoxy with 20 percent minimum volume ceramic quartz pigment, Protecto 401 by Induron Coating, "or-equal", for sewer service. Ceramapure by Induron Coating, "or-equal", for NSF 61 and potable water service. Lining shall be applied above 40 degrees F ambient temperature and shall not be applied to flange faces. Lining thickness shall be tested using a magnetic film thickness gauge. Lining integrity shall be tested on surfaces with a nondestructive, 2,500-volt dielectric resistance test.

SECTION 40 27 00.01 CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Fittings	Lined and coated same as pipe. Push-on: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 ductile iron, 250 psi minimum working pressure. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 ductile iron, 250 psi minimum working pressure. Follower glands shall be ductile iron. Proprietary Restrained: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Restraint shall be achieved with removable metal elements fitted between a welded bar on the pipe barrel and the inside of the joint bell or fitting sizes smaller than 16 inches may be mechanical joint, restrained by anchor gland followers, ductile iron anchor type, wedge action, with break-off tightening bolts. Assembled joints shall be rated for deflection in operation at rated pressure. Rated deflection shall be not less than 1-1/2 degrees for 36-inch and smaller pipe. Rated deflection shall be not less than 1/2 degree for 42-inch and larger pipe. Clow Corp., American Cast Iron Pipe Co., U.S. Pipe. Restrained joints relying on metal teeth molded into the gasket to prevent joint separation under pressure will not be accepted. Grooved End: AWWA C606 and AWWA C110/A21.10, ductile iron, 250 psi minimum working pressure; Victaulic. Flange: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face or ASME B16.1, Class 250 raised face**.** Gray cast iron will not be allowed.

SECTION 40 27 00.01 CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Joints	Push-on: 250 psi minimum working pressure, AWWA C110/A21.10 and AWWA C111/A21.11. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: 250 psi minimum working pressure. Proprietary Restrained: 150 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure; Victaulic. Flange: Dimensions per AWWA C110/A21.10 flat face or ASME B16.1 Class 250 raised face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed. Branch connections 3 inches and smaller, shall be made with service saddles as specified in Section 40 27 01, Process Piping Specialties.
Couplings	Grooved End: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic. Grooved End Adapter Flanges: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard. Flanged: ASTM A307, Grade B carbon steel heavy hex head or stud bolts, ASTM A563, Grade A carbon steel heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations. Flanged Joints in Sumps, Wet Wells, and Submerged and Wetted Installations: Type 316 stainless steel, ASTM A320/A320M, Grade B8M heavy hex head or stud bolts; ASTM A194/A194M, Grade 8M heavy hex nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations.

SECTION 40 27 00.01 CERAMIC-EPOXY-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Gaskets	General: Gaskets in contact with potable water shall be NSF ANSI 61 certified.Push-on, Mechanical and Proprietary Restrained Joints; Water and Sewage Service: Halogenated butyl or EPDM, Shore A hardness durometer 60, conforming to AWWA C111/A21.11. Grooved End Joints: Halogenated butyl conforming to ASTM D2000 and AWWA C606. Flanged, Water, Sewage and Hot Air Services: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 275 degrees F, conforming to ASME B16.21 and ASTM D2000. Full face for flat-faced flanges, flat-ring type for raised-face flanges. Blind flanges shall be epoxy-lined in accordance with the system specified above. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard.

END OF SECTION

SECTION 40 27 00.06 PVDF-LINED STEEL PIPE AND DUCTILE IRON FITTINGS	
Item	**Description**
PVDF Lining	Polyvinylidene fluoride (PVDF) meeting requirements of ASTM D3222, Minimum lining thicknesses for nominal pipe sizes: 2" & smaller 1/16 inch thick 3" 5/64 inch thick 4" 3/32 inch thick 6" 1/8 inch thick 8" thru 12" 5/32 inch thick
Pipe	PVDF-lined black carbon steel pipe; seamless, ERW, or electric welded meeting requirements of ASTM A53/A53M, ASTM A106/A106M, ASTM A135/A135m, or ASTM A587, Resistoflex, Edlon Unit of Robbins & Myers, Dow Chemical USA. Minimum Pipe Wall Thickness: 3" & smaller Schedule 40 4" & larger Schedule 20
Fittings	PVDF-lined ASME B16.42, Class 150 flanged ductile iron meeting requirements of ASTM A395/A395M, Resistoflex, Edlon Unit of Robbins & Myers, Dow Chemical USA or ASME B16.5, Class 150 flanged cast steel meeting requirements of ASTM A216/A216M, Grade WCB, Resistoflex, Edlon Unit of Robbins & Myers, Dow Chemical USA. Fabricated carbon steel fittings composed of PVDF-lined 150-pound carbon steel flanges in accordance with this data sheet, PVDF-lined carbon steel pipe in accordance with this data sheet, and PVDF-lined carbon steel butt-weld fittings meeting the requirements of ASTM A234/A234M, Grade WPB, wall thickness same as pipe.
Pipe and Fitting Vents	Install 1/16-inch minimum to 1/8-inch maximum diameter vent holes in the pipe wall: one vent every 36 inches along the pipe rotated approximately 90 degrees to the preceding vent; one vent every 18 inches along field-flared pipe rotated approximately 90 degrees to the preceding vent; minimum of two vents per pipe spool; two vents 180 degrees apart located within 6 inches of each flange. Provide vent extensions to the outside of pipe insulation or other overwrap. Use 1/8 inch, 2,000-pound or 3,000-pound WOG, half couplings welded to the pipe before lining is installed with a 1/8-inch carbon steel pipe for the vent.

SECTION 40 27 00.06 PVDF-LINED STEEL PIPE AND DUCTILE IRON FITTINGS	
Item	**Description**
Joints	Flanged.
Flanges	ASME B16.42, Class 150 ductile iron Van Stone (lap joint) or threaded meeting the requirements of ASTM A395/A395M or ASME B16.5, Class 150 carbon steel Van Stone (lap joint), slip-on or socket-weld meeting the requirements of ASTM A105/A105M or ASTM A181/ A181M. Flange facing to be molded PVDF or extended and flared PVDF pipe or fitting lining forming a raised-face gasket surface.
Bolting	Carbon steel, ASTM A307, Grade B square head bolts and ASTM A563, Grade A heavy hex head nuts. Corrosive Conditions: Stainless steel, ASTM A193/A193M, Grade B8M studs and ASTM A194/A194M, Grade 8M hex head nuts.
Gaskets	Tetrafluoroethylene (TFE) envelope, flat ring type. When the mating flange has a flat face, provide a filler gasket between the outside diameter of the raised-face PVDF flange liner and the flange outside diameter to protect the flange from excessive bolting moment.

END OF SECTION

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 and AWWA C900 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. ASTM D2152 for extruded and molded types. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassemble. Buried AWWA C900 shall be Restrained Joint.
Flanges	All	One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts, ASTM A194/A194M Grade 8M hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick Durlon, 9200W RCA, Garlock Gylon 3510. Raised Face Mating Flange: Flat ring 1/8-inch Durlon, 9200W RCA, Garlock Gylon 3510, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment. Internal Restraint: Elastomeric conforming to ASTM F477.
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service, IPS Weld-On 724 or approved equal. Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

SECTION 40 27 00.14 HIGH DENSITY POLYETHYLENE (HDPE) PIPE		
Item	**Size**	**Description**
General	All	Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
Pipe		ASTM D3550, high density polyethylene, maximum allowable hoop stress 800 psi at 73.4 degrees F.DIPS OD basis. Polyethylene resins shall conform to Type PE 3408, or better. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. Pressure rating/SDR of pipe shall be that listed for the specific service/flowstream identified in the Piping Schedule of Section 40 27 00 Process Piping-General. Pipe wall thickness shall reflect the required SDR* and diameter, as follows: PRESSURE RATING — SDR* 250 — 7.3 200 — 9 160 — 11 125 — 13.5 110 — 15.5 100 — 17 80 — 21 Design Stress Rating: ASTM F714, 800 psi hydrostatic. * SDR: Standard Dimension Ratio = OD/thickness
Fittings	6" & smaller	Molded fittings, butt fusion joined, conforming to ASTM D1248. All fittings shall have same pressure rating as pipe, unless otherwise noted.
	8" & larger	Same as pipe, butt fusion joined, conforming to ASTM D3350. All fittings shall have same pressure rating as pipe, unless otherwise noted.

SECTION 40 27 00.14 HIGH DENSITY POLYETHYLENE (HDPE) PIPE		
Item	**Size**	**Description**
Flanges		Van Stone type, cast ASTM A351/A351M, Type 316 stainless steel backing ring, IPP Deltaflex convoluted design or equal for bolting to ANSI B16.1, Class 125; ANSI B16.5, Class 150; and AWWA C207, Class E. Pressure performance of the backing ring equal to SDR rating of the pipe with safety factor of two. Stub ends same grade HDPE and pressure rating as pipe.
Bolting		Type 316 Stainless steel, ASTM A193/A193M Rev A Grade B8M studs and ASTM B98 silicon bronze hex head (full) nuts. Washers shall be same material as bolts.
Transition Adapters (e.g., HDPE to stainless steel Iron Pipe Size [IPS] Flange end connections)	All	As specified in Section 40 27 01, Piping Specialties – Plant Services.
Gaskets		Flat ring, 1/8-inch ethylene propylene rubber (EPR).

END OF SECTION

SECTION 40 27 01
PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
   b. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
2. American Water Works Association (AWWA):
   a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   b. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
   c. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   d. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   e. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   f. Manual M11, Steel Pipe—A Guide for Design and Installation.
3. ASTM International (ASTM):
   a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.
4. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
5. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).
2. Metal Bellows Field Finishing:
   a. Manufacturer's recommended weld procedures for joining welded carbon steel piping to stainless steel bellows.

b. Welder qualifications for joining welded carbon steel piping to stainless steel bellows.
c. Product data for field-applied System No. 4, high temperature, epoxy lining and coating in accordance with Section 09 90 00, Painting and Coating.

B. Informational Submittals:

1. Coupling Harness:
a. Details, ratings, calculations and test reports for thrust restraints relying on welded bars or rings.
b. Weld procedure qualifications.
c. Load proof-testing report of prototype restraint for any size coupling.

C. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.

B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.02 CONNECTORS

A. Teflon Bellows Connector for Nonmetallic Pipe:

1. Type: Two convolutions, unless otherwise shown, with metal reinforcing bands.
2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
3. Working Pressure Rating: 140 psi, minimum, at 120 degrees F.
4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
5. Manufacturers and Products:
a. Garlock; Style 214.
b. Resistoflex; No. R6904.
c. Unisource Manufacturing, Inc.; Style 112.
d. Proco Products, Inc.; Series 442.

B. Elastomer Bellows Connector for Grit Piping and Corrosive Services:

1. Type: Fabricated spool, with single filled arch.
2. Materials: Nitrile tube and wrap-applied neoprene cover.
3. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with full elastomer face and steel retaining rings.
4. Working Pressure Rating: 140 psig, minimum, at 180 degrees F for sizes 12 inches and smaller.
5. Thrust Restraint: Control rods to limit travel of elongation and compression.
6. Manufacturers and Products:
   a. Goodall Rubber Co.; Specification E-1462.
   b. Garlock; Style 204.
   c. Unisource Manufacturing, Inc.; Style 1501.
   d. Proco Products, Inc.; Series 220.

C. Flexible Metal Hose Connector:

1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Bronze.
3. End Connections: Female copper solder joint.
4. Minimum Burst Pressure: 500 psig at 70 degrees F.
5. Length: Minimum manufacturer recommendation for vibration isolation.
6. Manufacturers:
   a. U.S. Hose Corp.; Series 300.
   b. Anamet Industrial, Inc.
   c. Unisource Manufacturing, Inc.
   d. Proco Products, Inc.

2.03 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.
3. Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
4. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA Manual M11 or as shown on Drawings.
5. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.

B. Flexible Sleeve Type Coupling:

1. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser Piping Specialties; Style 38.
      2) Smith-Blair, Inc.; Style 411.
   b. Ductile Iron Pipe:
      1) Dresser Piping Specialties; Style 253.
      2) Smith-Blair, Inc.; Style 441.

C. Transition Coupling for Steel Pipe:

1. Manufacturers and Products:
   a. Dresser Piping Specialties; Style 162.
   b. Smith-Blair, Inc.; Style 413.

D. Flanged Coupling Adapter:

1. Anchor studs where required for thrust restraint.
2. Manufacturers and Products:
   a. Steel Pipe:
      1) Dresser Piping Specialties; Style 128.
      2) Smith-Blair, Inc.; Style 913.
   b. Ductile Iron Pipe:
      1) Dresser Piping Specialties; Style 128.
      2) Smith-Blair, Inc.; Style 912.

E. Restrained Flange Adapter:

1. Pressure Rating:
   a. Minimum Working Pressure Rating: Not less than 150 psi.
   b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
2. Thrust Restraint:
   a. Provide hardened steel wedges that bear against and engage outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
   b. Products employing set screws that bear directly on pipe will not be acceptable.
3. Manufacturer and Product: EBAA Iron Sales Co.; Mega-Flange.

2.04 EXPANSION JOINTS

A. Elastomer Bellows for Grooved Joints and Flanged Piping:

1. Type: Reinforced molded wide arch.
2. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with split galvanized steel retaining rings.
3. Washers: Over retaining rings to help provide leak-proof joint under test pressure.
4. Thrust Protection: Control rods to protect the bellows from overextension.
5. Bellows Arch Lining: Buna-N, nitrile, or butyl.
6. Rated Temperature: 250 degrees F.
7. Rated Deflection and Pressure:
   a. Lateral Deflection: 3/4 inch, minimum.
   b. Burst Pressure: Four times the working pressure.
   c. Compression deflection and minimum working pressure as follows:

Size (inch)	**Deflection (inch)**	**Pressure (psig)**
2-1/2 to 12	1.06	150
14	1.65	130
16 to 20	1.65	110

8. Manufacturers and Products:
   a. General Rubber Corp.; Style 1015 Maxijoint.
   b. Mercer; Flexmore Style 450.
   c. Goodall Rubber Co.; Specification E-711.
   d. Unisource Manufacturing, Inc.; Series 1500.
   e. Proco Products, Inc.; Series 251.

B. Teflon Bellows for Nonmetallic Pipe:

1. Type: Three convolutions, with metal reinforcing bands.
2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
3. Working Pressure Rating: 100 psig, minimum, at 120 degrees F.
4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
5. Manufacturers and Products:
   a. Garlock; Style 215.
   b. Resistoflex; No. R6905.
   c. Unisource Manufacturing, Inc.; Style 113.
   d. Proco Products, Inc.; Series 443.

C. Flexible Metal Hose:

1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Stainless steel, ASTM A276, Type 321.
3. End Connections:
   a. 3 Inches and Larger: Shop fabricated flanged ends to match mating flanges.
   b. 2-1/2 Inches and Smaller: Screwed ends with one union end.
4. Minimum Burst Pressure: 600 psig at 70 degrees F for 12 inches and smaller.
5. Length: Provide hose live-length equal to lengths shown on Drawings.
6. Manufacturer:
   a. U.S. Hose Corp.; Series 401M.
   b. Anamet Industrial, Inc.; BWC21-1.

2.05 FLEXIBLE EXPANSION JOINTS FOR SEAL WATER LINES AND TUBING

A. Design:

1. Ball and socket type for earth settlement compensation.
2. Joints shall be double ball assemblies rated for 15-degree minimum deflection and not less than 4 inches offset from centerline of connecting piping.
3. Assembly shall accommodate up to 4 inches of expansion in length.
4. Ductile iron conforming to AWWA C153/A21.53.
5. Rated for 350 psi.
6. Components shall be lined and coated by manufacturer with fusion-bonded epoxy on all surfaces not bearing gaskets.
7. End Connections: Flanged or mechanical joint as shown and as required by connecting pipe and fittings.
8. Joint connecting to mechanical joint shall be thrust restrained.
9. Bonding:
   a. Manufacturer shall factory install thermite welded joint bonds for assembled expansion joint.
   b. Provide 24-inch bond wires for field bonds to adjacent metallic piping.
   c. Bond wires shall be 2 AWG with two 12-inch-long THHN insulated 12 AWG wire pigtails.

B. Manufacturer and Product: EBAA Iron Sales Co.; Flex-Tend.

2.06 SEAL WATER HOSE

A. Product as specified for water hose, except 3/8 inch with male NPT ends, in 2-foot lengths.

2.07 SERVICE SADDLES

A. Double-Strap Iron:

1. Pressure Rating: Capable of withstanding 150 psi internal pressure without leakage or over stressing.
2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
3. Taps: Iron pipe threads.
4. Materials:
   a. Body: Malleable or ductile iron.
   b. Straps: Galvanized steel.
   c. Hex Nuts and Washers: Steel.
   d. Seal: Rubber.
5. Manufacturers and Products:
   a. Smith-Blair; Series 313 or 366.
   b. Dresser; Style 91.

2.08 PIPE SLEEVES

A. Steel Pipe Sleeve:

1. Minimum Thickness: 3/16 inch.
2. Seep Ring:
   a. Center steel flange for water stoppage on sleeves in exterior or water-bearing walls, 3/16-inch minimum thickness.
   b. Outside Diameter: Unless otherwise shown, 3 inches greater than pipe sleeve outside diameter.
   c. Continuously fillet weld on each side all around.
3. Factory Finish:
   a. Galvanizing:
      1) Hot-dip applied, meeting requirements of ASTM A153/A153M.
      2) Electroplated zinc or cadmium plating is unacceptable.
   b. Shop Lining and Coating: Factory prepare, prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

B. Molded Polyethylene Pipe Sleeve:

1. Molded HDPE with integral water stop ring not less than 3 inches larger than sleeve.
2. Provided with end caps for support during concrete placement.
3. Manufacturer and Product: Century-Line, Model CS sleeves as manufactured by PSI-Thunderline/Link-Seal.

C. Insulated and Encased Pipe Sleeve:

1. Manufacturer and Product: Pipe Shields, Inc.; Models WFB, WFB-CS and -CW Series, as applicable.

D. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Fabrication:
   a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
   b. Pressure plates shall be reinforced nylon polymer.
3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening, and to withstand a hydrostatic head of 40 feet of water**.**
4. Manufacturer: Thunderline Corp., Link-Seal Division.

2.09 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:

1. Diameter, Lining, and Ends: Same as connecting ductile iron pipe.
2. Thickness: Equal to or greater than remainder of pipe in line.
3. Fittings: In accordance with applicable Pipe Data Sheet.
4. Thrust Collars:
   a. Rated for thrust load developed at 250 psi.
   b. Safety Factor: 2, minimum.
   c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.
5. Manufacturers:
   a. American Cast Iron Pipe Co.
   b. U.S. Pipe and Foundry Co.

B. Steel or Stainless Steel Wall Pipe:

1. Same material and thickness as connecting pipe, except 1/4-inch minimum thickness.
2. Lining: Same as connecting pipe.
3. Thrust Collar:
   a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.
   b. Continuously fillet welded on each side all around.

2.10 MISCELLANEOUS SPECIALTIES

A. Strainers, Water Service, 2 Inches and Smaller:

1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20-mesh.
3. Manufacturers and Products:
   a. Armstrong International; Inc.; Model F.
   b. Mueller Steam Specialty; Model 351M.

B. Water Hose:

1. Furnish 2 50-foot lengths of 1-1/2-inch rubber hose. EPDM black cover and EPDM tube, reinforced with two textile braids. Provide each length with brass male and female NST hose thread couplings to fit hose nozzle and hose valve.
2. Rated minimum working pressure of 200 psi.
3. Manufacturers:
   a. Goodyear.
   b. Boston.

C. Hose Nozzles:

1. Furnish 2 1-1/2-inch cast brass, satin finish, nozzles with adjustable fog, straight-stream, and shut-off feature and rubber bumper. Provide nozzles with female NST hose thread.
2. Manufacturers:
   a. Croker.
   b. Elkhart.

D. Pump Seal Water Sight Flow Indicators:

1. Bronze body, 3/8-inch, horizontal, ball action with tempered glass.
2. Rated 125 psi with NPT screwed ends.

3. Operate with a minimum flow of 0.25 gpm.
4. Manufacturers and Products:
   a. Eugene Ernst Co.; Series E-57-4.
   b. Jacoby Tarbox Co.

PART 3 EXECUTION

3.01 GENERAL

A. Provide accessibility to piping specialties for control and maintenance.

3.02 PIPING FLEXIBILITY PROVISIONS

A. General:

1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping—General.
2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

B. Flexible Joints at Concrete Backfill or Encasement: Install within 18 inches or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Flexible Joints at Concrete Structures: Install 18 inches or less from face of structures; joint may be flush with face.

3.03 PIPING TRANSITION

A. Applications:

1. Provide complete closure assembly where pipes meet other pipes or structures.
2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown.
3. Restrained Joint Pipe Closures: Install with thrust tie-rod assemblies as shown.
4. Gravity Pipe Closures: As specified for pressure pipelines, or concrete closures.
5. Concrete Closures: Use to make connections between dissimilar pipe where standard rubber gasketed joints or flexible couplings are impractical, as approved.
6. Elastomer sleeves bonded to pipe ends are not acceptable.

B. Installation:

1. Flexible Transition Couplings:
   a. Install in accordance with coupling manufacturer's instructions to connect dissimilar pipe and pipes with a small difference in outside diameter.
   b. Install a second flexible joint, whether or not shown.
   c. Pipe Diameter 18 Inches and Smaller: Within 18 inches of first joint.
   d. Pipe Diameter Larger than 18 Inches: Within one pipe diameter of first joint.

3.04 PIPING EXPANSION

A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.

B. Expansion Joints:

1. Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.
2. Nonmetallic Pipe: Teflon bellows expansion joint.
3. Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
4. Air and Water Service above 120 Degrees F: Metal bellows expansion joint.
5. Pipe Run Offset: Flexible metal hose.

C. Anchors: Install as specified in Section 40 05 15, Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

3.05 SERVICE SADDLES

A. Ferrous Metal Piping (except stainless steel): Double-strap iron.

B. Plastic Piping: Nylon-coated iron.

3.06 COUPLINGS

A. General:

1. Install in accordance with manufacturer's written instructions.
2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.

3. Application:
    a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
    b. Concrete Encased Couplings: Flexible coupling.

3.07 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

B. Product Applications Unless Shown Otherwise:

1. Nonmetallic Piping: Teflon bellows connector.
2. All Other Piping: Elastomer bellows connector.

C. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

3.08 PIPE SLEEVES

A. Application:

1. As specified in Section 40 27 00, Process Piping—General.
2. Above Grade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
3. Below Grade or in Submerged or Damp Environments: Shop-lined and coated.
4. Alternatively, Molded Polyethylene Pipe Sleeve as specified may be applied.

B. Installation:

1. Support noninsulating type securely in formwork to prevent contact with reinforcing steel and tie-wires.
2. Caulk joint with specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

3.09 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:

1. Watertight and Below Ground Penetrations:
    a. Wall pipes with thrust collars.
    b. Provide taps for stud bolts in flanges to be set flush with wall face.

2. Nonwatertight Penetrations: Pipe sleeves with seep ring.
3. Existing Walls: Rotary drilled holes.
4. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09 90 00, Painting and Coating.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie-wires.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Gas Association (AGA): 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids.
2. American National Standards Institute (ANSI): Z21.15, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
3. American Society of Mechanical Engineers (ASME):
   a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   b. B16.44, Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi.
4. American Society of Sanitary Engineers (ASSE): 1011, Performance Requirements for Hose Connection Vacuum Breakers.
5. American Water Works Association (AWWA):
   a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   b. C500, Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
   d. C508, Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
   e. C509, Resilient-Seated Gate Valves for Water Supply Service.
   f. C510, Double Check Valve Backflow Prevention Assembly.
   g. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   j. C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   k. C542, Electric Motor Actuators for Valves and Slide Gates.
   l. C550, Protective Interior Coatings for Valves and Hydrants.
   m. C606, Grooved and Shouldered Joints.
   n. C800, Underground Service Line Valves and Fittings.

6. ASTM International (ASTM):
    a. A276, Standard Specification for Stainless Steel Bars and Shapes.
    b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
    c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
    d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
    e. B61, Standard Specification for Steam or Valve Bronze Castings.
    f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
    g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
    h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
    i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
    j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
    k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
    l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
    m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
    n. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
7. Canadian Standards Association, Inc. (CSA): 9.1, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
8. Chlorine Institute (CI): Pamphlet 6, Piping Systems for Dry Chlorine.
9. FM Global (FM).
10. Food and Drug Administration (FDA).
11. International Association of Plumbing and Mechanical Officials (IAPMO).
12. Manufacturers Standardization Society (MSS):
    a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
    b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
    c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
    d. SP-88, Diaphragm Valves.
    e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

13. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
14. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
15. Underwriters Laboratories (UL).
16. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
    b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Power and control wiring diagrams, including terminals and numbers.
    d. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
    e. Sizing calculations for open-close/throttle and modulating valves.
    f. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
    a. Electric actuators; full compliance with AWWA C542.
3. Tests and inspection data.
4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Size operators and actuators to operate valve for full range of pressures and velocities.

G. Valve to open by turning counterclockwise, unless otherwise specified.

H. Factory mount operator, actuator, and accessories.

2.02 SCHEDULE

A. Additional requirements relative to this section are shown on Electric Motor Actuated Valve Schedule and Self-Regulated Valve Schedule located at the end of this section.

2.03 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

2.04 FACTORY FINISHING

A. General:

1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
2. Exterior coating for valves and hydrants shall be in accordance with Section 09 90 00, Painting and Coating.
3. Exposed safety isolation valves and lockout valves with handles, handwheels, or chain wheels shall be "safety yellow."

B. Where epoxy lining and coating are specified, factory finishing shall be as follows:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion bonded" epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.05 VALVES

A. Ball Valves:

1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:
   a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Threaded:
         a) Conbraco Apollo; 70-100.
         b) Nibco; T-580-70.
      2) Soldered:
         a) Conbraco Apollo; 70-200.
         b) Nibco; S-580-70.

2. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
   a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends, ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 psig CWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 76F-100 Series.
      2) Nibco; T-585-S6-R-66-LL.

3. Type V307 Stainless Steel Ball Valve 2 Inches and Smaller:
   a. Three-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end pieces, Type 316 stainless steel ball, NPT threaded ends, reinforced PTFE seats, seals, and packing, adjustable packing gland, blowout-proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 800 psig to 1,000 psig CWP, complies with MSS SP-110.
   b. Manufacturers and Products:
      1) Conbraco Apollo; 86R-100/86-500 Series.
      2) Nibco; T-595-S6-R-66-LL.
4. Type V330 PVC Ball Valve 2 Inches and Smaller:
   a. Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball for chlorine solution service.
   b. Manufacturers and Products:
      1) Nibco; Chemtrol Tru-Bloc.
      2) ASAHI/America; Type 21.
      3) Spears; True Union.

B. Plug Valves:

1. Type V405 Eccentric Plug Valve 3 Inches to 12 Inches:
   a. Nonlubricated type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joint ends, unless otherwise shown.

b. Plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna-N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings, or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.

c. Adjustable packing shall be Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower. Packing gland shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly, except the gland follower. Non-adjustable packing or packing requiring actuator removal to replace the packing, is not acceptable.

d. For buried service, provide external epoxy coating.

e. Operators:
   1) 3-Inch to 4-Inch Valves: Wrench lever manual.
   2) 6-Inch to 12-Inch Valves: Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.

f. Manufacturers and Products:
   1) Pratt; Ballcentric.
   2) DeZurik; Style PEC.
   3) Milliken; Millcentric Series 600.
   4) M&H EPV. [Add No. 1]

2. Type V406 Eccentric Plug Valve 14 Inches to 20 Inches:

a. Nonlubricated type rated 150 psig CWP, drip-tight shutoff with pressure from either direction, cast-iron body, exposed service flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints, buried service mechanical joints ends, unless otherwise shown, plug cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna-N, seats welded nickel, stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit seals on both upper and lower bearings.

b. Totally enclosed, geared, manual operator with handwheel, 2-inch nut or chain wheel. Size operator for 1.5 times maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher. For buried service, provide completely sealed operator filled with heavy lubricant and 2-inch nut.

c. For buried service, provide external epoxy coating.
d. Manufacturers and Products:
1) Pratt; Ballcentric.
2) DeZurik; Style PEC.
3) Milliken; Millcentric Series 600.

C. Self-Regulated Automatic Valves:

1. Type V750 Sewage Air and Vacuum Valve 2 Inches to 14 Inches:
a. Suitable for sewage service; automatically exhausts air during system filling and allows air to re-enter during draining or when vacuum occurs.
b. Rated working pressure of 150 psi, 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ASME B16.1 Class 125 flanged inlet and threaded cover outlet, built and tested to AWWA C512.
c. Materials: Cast-iron or ductile iron body and cover, concave or skirted stainless steel float and trim, Buna-N seat.
d. Sewage air and vacuum valve fitted with blowoff valve, flushing valve with quick disconnect couplings, and a minimum 5 feet of hose with quick disconnect couplings to permit backflushing after installation without dismantling valve.
e. Manufacturers and Products:
1) APCO Valve and Primer Corp.; Series 401 SAVV to 414 SAVV.
2) Val-Matic Valve; Series 301 to 306.

D. Miscellaneous Valves:

1. Type V940 Solenoid Valve 1/4 Inch to 2 Inches:
a. Two-way internal pilot operated diaphragm type, brass body, resilient seat suitable for air or water, solenoid coil molded epoxy, NEMA insulation Class F, 120 volts ac, 60-Hz, unless otherwise indicated. Solenoid enclosure NEMA 250, Type 4 unless otherwise indicated. Size and normal position (when de-energized) as indicated on drawings.
b. Minimum operating pressure differential no greater than 5 psig, maximum operating pressure differential not less than 125 psig.
c. Manufacturers and Products:
1) ASCO.
2) Skinner.

2.06 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
   a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
   b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
   c. Operator self-locking type or equipped with self-locking device.
   d. Position indicator on quarter-turn valves.
   e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator:
   a. Galvanized and painted handwheel.
   b. Cranks on gear type operator.
   c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
   d. Valve handles to take a padlock, and wheels a chain and padlock.
3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

2.07 ACCESSORIES

A. Tagging: 1-1/2-inch diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve 4 inches and larger.

B. Limit Switch:

1. Factory installed NEMA 4X limit switch by actuator manufacturer.
2. SPST, rated at 5 amps, 120 volts ac.

C. T-Handled Operating Wrench:

1. Two each galvanized operating wrenches, 4 feet long.
2. Manufacturers and Products:
   a. Mueller; No. A-24610.
   b. Clow No.; F-2520.
3. One each galvanized operating keys for cross handled valves.

D. Extension Bonnet for Valve Operator: Complete with enclosed stem, extension, support brackets, and accessories for valve and operator.

1. Manufacturers and Products:
   a. Pratt.
   b. DeZurik.

E. Floor Box:

1. Plain type, for support of nonrising type stem.
2. Complete with solid extension stem, operating nut, and stem guide brackets. Stem length as required to extend valve operating nut to within 3 inches of finish floor.
3. Stem Guide: Space such that stem L/R ratio does not exceed 200.
4. Anchor Bolts: Type 304 stainless steel.
5. Manufacturers and Products:
   a. Neenah Foundry; R 7506.
   b. Clow; No. F5690.

F. Chain Wheel and Guide:

1. Handwheel direct-mount type.
2. Complete with chain.
3. Galvanized or cadmium-plated.
4. Manufacturers and Products:
   a. Clow Corp.; Figure F-5680.
   b. Walworth Co.; Figure 804.
   c. DeZurik Corp.; Series W or LWG.

G. Indicator Post Assembly:

1. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.
2. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
3. Padlockable eye bolt for wrench.
4. Adjustable bury depth. Bury depth as required for valve installation.
5. UL Listed and FM Approved.
6. Manufacturers and Products:
   a. Clow; Style 2945.
   b. Mueller; A-20806.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC and CPVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
   a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
   b. Install valves in location for easy access for routine operation and maintenance.
   c. Install valves per manufacturer's recommendations.
2. Gate, Globe, and Ball Valves:
   a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
   b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.

3. Eccentric Plug Valves:
    a. Unless otherwise restricted or shown on Drawings, install valve as follows:
        1) Liquids with suspended solids service with horizontal flow: Install valve with stem in horizontal position with plug up when valve is open. Install valve with seat end upstream (flow to produce unseating pressure).
        2) Liquids with suspended solids service with vertical flow: Install valve with seat in highest portion of valve (seat up).
        3) Clean Liquids and Gas Service: Install valve with seat end downstream of higher pressure when valve is closed (higher pressure forces plug into seat).
4. Solenoid Valves: Install in accordance with manufacturer's instructions.

E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

F. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

G. Extension Stem for Operator: Where depth of valve operating nut is 3 feet or greater below finish grade, furnish operating extension stem with 2-inch operating nut to bring operating nut to a point within 6 inches of finish grade.

H. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of valve.

I. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

J. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.

3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.

E. Set, verify, and record set pressures for relief and regulating valves.

F. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

3.03 MANUFACTURER'S SERVICES

A. Valve(s) as listed below require manufacturer's field services:

1. Electric Actuated Valves (Valve Actuator Manufacturer).
2. V306, V307, V330, V405, V406, V750.

B. Manufacturer's Representative: Present at Site for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection, functional and performance testing, and completion of Manufacturer's Certificate of Proper Installation.

C. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.04 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Solenoid Valve Schedule.

END OF SECTION

Solenoid Valve Schedule							
Tag No.	**Valve Type No.**	**Size (inches)**	**Fluid**	**Max Operating Flow**	**Maximum ΔP (psig)**	**Travel Time**	**Actuator Type and Control Features**
FV-12-21	V940	1 1/2"	W3	14 gpm	60 psig	30 sec	A, C
FV-12-22	V940	1 1/2"	W3	14 gpm	60 psig	30 sec	A, C

Note:

1. Provided by Screen Manufacturer.

Actuator Type and Control Features:

A = Vane Type Actuators

B = Valve shall be explosion-proof suitable for service in a Class I, Div I environment

C = Valve shall close upon loss of signal.

D = Valve shall remain in last position upon loss of signal

E = Visual indicator.

F = Manual hand wheel override.

G = Limit Switch

SECTION 40 42 13
PROCESS PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
2. ASTM International (ASTM):
   a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   b. C165, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
   c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   e. C534/C534M, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   f. C547, Standard Specification for Mineral Fiber Pipe Insulation.
   g. C552, Standard Specification for Cellular Glass Thermal Insulation.
   h. C585, Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
   i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   j. C1729, Standard Specification for Aluminum Jacketing for Insulation.
   k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   l. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
3. International Code Council (ICC): International Energy Conservation Code (IECC).
4. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals: Manufacturer’s descriptive literature.

B. Informational Submittals: Maintenance information.

PART 2 PRODUCTS

2.01 PIPE AND FITTING INSULATION

A. Type 1—Elastomeric:

1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534/C534M.
2. Temperature Rating: Minus 297 degrees F to 220 degrees F.
3. Nominal Density: 3 pcf to 6 pcf.
4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in./hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
5. Maximum water vapor transmission of 0.06 perm-inch per ASTM E96/E96M, Procedure A.
6. Joints: Manufacturer’s adhesive.
7. Flame Spread Rating: Less than 25 per ASTM E84.
8. Smoke Developed Index: Less than 50 per ASTM E84.
9. Manufacturers and Products:
   a. Nomaco; K-Flex.
   b. Armacell; AP Armaflex.

B. Type 2—Fiberglass:

1. Material: UL rated, preformed, sectional bonded fiberglass per ASTM C585 with factory applied, Kraft paper with aluminum foil vapor barrier jacket with pressure-sensitive, self-sealing lap.
2. Insulation Temperature Rating: Zero to 850 degrees F.
3. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.23 Btu-in./hr-square foot degrees F at 75 degrees F.
4. Jacketing per ASTM C1136 with minimum water vapor transmission for jacket of 0.02 perm-inch per ASTM E96/E96M. Furnish with no jacket if field finish system specified.
5. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
6. Flame Spread Rating: Less than 25 per ASTM E84.

7. Smoke Developed Index: Less than 50 per ASTM E84.
8. Manufacturers and Products:
   a. Owens Corning Fiberglass; ASJ/SSL-11.
   b. John Manville; Micro-Lok with Jacket.

C. Type 3—Foamglass:

1. Material: Cellular glass per ASTM C552.
2. Nominal Density: 7.5 pcf.
3. Compressive Strength: 90 psi per ASTM C165.
4. Temperature Rating: Minus **[A: 290] [B: 450]** degrees F to 900 degrees F.
5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in./hr-square foot degrees F.
6. Minimum water vapor transmission for insulation of 0.00 perm-inch per ASTM E96/E96M.
7. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
8. Flame Spread Rating: 0 per ASTM E84.
9. Smoke Developed Index: 0 per ASTM E84.
10. Follow manufacturer's recommendation, based upon temperature of piping to be insulated.
11. Manufacturer and Product: Pittsburgh Corning; Foamglas One.

2.02 ROOF DRAIN AND OVERFLOW DRAIN SUMP INSULATION

A. Type 1: 1 inch thick.

2.03 INSULATION AT PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support Systems.

B. Copper, Ductile Iron, and Nonmetallic Pipe: High-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured pre-insulated pipe hanger and insulation shield. Extend insert beyond shield.

C. Steel Pipe: Insulation saddle or high-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured pre-insulated pipe hanger and insulation shield at support location. Extend insert beyond shield.

2.04 INSULATION FINISH SYSTEMS

A. Type F1—PVC:

1. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, for straight run piping and fitting locations, temperatures to 140 degrees F.
2. Color: PVC jacketing shall be color coded to match colors listed in pipe schedule where suitable matching colors are available. If no suitable colors are available jacketing shall be white.
3. Flame Spread Rating: 25 per ASTM E84.
4. Smoke Developed Index: 50 per ASTM E84.
5. Manufacturers and Products:
    a. Knauf Insulation; Proto 1000.
    b. Johns Manville; Zeston 2000 or 300.
    c. Speedline; 25/50 Smoke-Safe.

B. Type F2—Paint:

1. Type 1 Insulation: Acrylic latex paint, white, and suitable for outdoor use.
    a. Manufacturer and Product: Armacell; WB Armaflex finish.
2. Type 2 Insulation: In accordance with Section 09 90 00, Painting and Coating.

C. Type F3—Aluminum:

1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, in accordance with ASTM C1729, minimum 0.016-inch thickness, with smooth mill finish.
2. Vapor Barrier: Provide factory applied vapor barrier, heat and pressure bonded to inner surface of aluminum jacketing.
3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
4. Manufacturers:
    a. RPR Products; Insul-Mate.
    b. ITW, Pabco-Childers.

D. Type F4—Foamglass Jacketing:

1. Type 3 Insulation—Buried and Up to 1 Foot Above Grade: 70-mil bituminous resin with woven, glass fabric, aluminum foil layer, and plastic film coating, self-sealing manual pressure seals; Pittsburgh Corning Pittwrap SS.
2. Type 3 Insulation—Greater that 1 Foot Above Grade: 30-mil modified bituminous membrane with self-sealing manual pressure seals; Pittsburgh Corning Pittwrap CW30.

PART 3 EXECUTION

3.01 APPLICATION

A. General:

1. Insulate valve bodies, flanges, and pipe couplings.
2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation Thickness: Refer to Supplement Service and Insulation Thickness table following "End of Section" and to Piping Schedule in Section 40 27 00, Process Piping—General.

3.02 INSTALLATION

A. General:

1. Install in accordance with manufacturer's instructions and as specified herein.
2. Install after piping system has been pressure tested and leaks corrected.
3. Install over clean dry surfaces.
4. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
5. Do not allow insulation to cover nameplates or code inspection stamps.
6. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
7. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
8. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

B. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

C. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

D. Placement:

1. Insulate valves and fittings with sleeved or cut pieces of same material.
2. Seal and tape joints.

E. Heat Traced Piping: Apply insulation after heat-tracing work is completed and inspected.

F. Roof Drains: Insulate vertical drops from roof drains to horizontal pipe, exposed and concealed horizontal piping, and 2 feet down on vertical risers from horizontal pipe.

G. Roof Drains and Overflow Drains: Insulate entire pipe runs. Where roof and overflow drains exist through an exterior wall ensure annular space between pipes and walls are properly sealed prior to insulating.

H. Roof Drain and Overflow Drain Sumps: Insulate entire sumps.

I. Vapor Barrier:

1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
3. Do not use staples and screws to secure vapor sealed system components.

J. Aluminum Jacket:

1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
4. Do not use screws or rivets to fasten fitting covers.
5. Install removable prefabricated aluminum covers on exterior flanges and unions.
6. Caulk and seal exterior joints to make watertight.

3.03 FIELD FINISHING

A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.

C. Painting Piping Insulation (Exposed to View):

1. Aluminum or color coded PVC jacketing does not require painting.
2. If insulated piping system is indicated to be painted in Section 40 27 00, Process Piping—General, piping shall receive the following:
   a. Prime coat in accordance with Section 09 90 00, Painting and Coating.
   b. Finished insulation (and not pipe) shall be painted in accordance with Section 09 90 00, Painting and Coating.

3.04 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this specification:

1. Service and Insulation Thickness Table.

END OF SECTION

Service and Insulation Thickness								
					Finish Systems			
Service Type	**Pipe Legend**	**Thickness**	**Fluid Temperature (degrees F)***	**Insulation**	**Concealed from View**	**Indoors Exposed**	**Outdoors**	**Buried**
HT–Piping requiring heat tracing.	See Specification 40 05 33	Pipe Size: Insulation Thickness Inches:* 1/4-3: 1 3.5-10: 1.5 12-16: 2 18-24: 2.5		Type 2	None	F1 for Pipes <=3" F3 for Pipes >3"	F3	NA

*Use these fluid temperatures unless otherwise noted in the Piping Schedule.
Inches*: Based upon insulation with glass fiber per ASTM C547, outdoors with 20 mph wind with 10 percent safety and no value assigned to cladding or air space at cladding. Matches the watts per foot in Section 40 05 33, Pipe Heat Tracing. 2012 IECC requires 1-inch minimum thickness.

SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
   a. Submit prior to testing and include at least the information that follows:
      1) Testing dates.
      2) Piping systems and section(s) to be tested.
      3) Test type.
      4) Method of isolation.
      5) Calculation of maximum allowable leakage for piping section(s) to be tested.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.

B. Pressure Piping:

1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
2. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
3. New Piping Connected to Existing Piping:
   a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
   b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Engineer.
4. Items that do not require testing include: Equipment seal drains,tank overflows to atmospheric vented drains,tank atmospheric vents.
5. Test Pressure: As indicated on Piping Schedule.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

Gravity Piping: Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:

1. Perform testing on installed piping prior to application of insulation.
2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
5. Examine joints and connections for leakage.
6. Correct visible leakage and retest as specified.
7. Empty pipe of water prior to final cleaning or disinfection.

C. Buried Piping:

1. Test after backfilling has been completed.
2. Expel air from piping system during filling.
3. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
4. Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.
5. Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.
6. Maximum Allowable Leakage: No Leakage Allowed.
7. Correct leakage greater than allowable, and retest as specified.

3.03 PNEUMATIC TEST FOR PRESSURE PIPING

A. Do not perform on:

1. PVC or CPVC pipe.
2. Piping larger than 18 inches.
3. Buried and other non-exposed piping.

B. Fluid: Oil-free, dry air.

C. Procedure:

1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
4. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
5. Correct visible leakage and retest as specified.

D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.04 PNEUMATIC TEST FOR GRAVITY PIPING

A. Equipment:

1. Install gauges, air piping manifolds, and valves at ground surface.
2. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.
3. Restrain plugs used to close sewer lines to prevent blowoff.

B. Procedure:

1. Require that no person enter manhole where pipe is under pressure.
2. Slowly introduce air into pipe section until internal air pressure reaches 4 psi greater than average back pressure of groundwater submerging pipe.
3. Allow 2 minutes minimum for air temperature to stabilize.

C. Allowable Leakage: Allowable Leakage is zero. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

D. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

3.05 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 40 90 00
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section gives general requirements for Process Instrumentation and Control System (PIC). The following PIC subsections expand on requirements of this section:

1. Section 40 91 00, Instrumentation and Control Components.

B. Major Work Items (include but are not limited to): Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for a complete PICS.

1. Plant instrumentation and monitoring and control equipment including primary elements, transmitters, control devices, control panels, and programmable controllers.
2. Upgrades to existing facility control panels and hardware as indicated in Contract Documents and as required to incorporate complete instrumentation and control system interface. Upgrades include, but are not limited to: Provide new Doppler flowmeter with panel and field surge suppression wired to existing PLC in CP-16-13, Rewiring existing PLC I/O from CP-16-3 to a new Headworks PLC Control Panel, and modifying existing FP-12-1 control panel to pass LSHH-12-2 through the panel without any PLC or relay control logic. Provide as-built drawings for each existing control panel modified by PICS.
3. Relocation of existing Sampler unit at Headworks and rewiring to existing I/O in CP-16-3.
4. Modify HMI graphics to remove existing Barscreen and add new Drum Screen and Doppler Flow. FP-12-3 on the Headworks Platform will be supplied by the vendor.
5. The existing iFIX SCADA and associated server hardware is scheduled to be replaced with a new VTSCADA HMI on a separate ongoing project. HMI changes will be performed on the SCADA HMI that is in active use during startup.
    a. Modifications to existing HMI graphics as necessary for display of I/O as shown on P&ID drawings.
    b. Modifications to existing overviews, summaries, run times, and cycle counts HMI graphics as necessary to change existing Barscreen to new Drum Screen.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section and other PIC subsections:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.
   c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   d. B32, Standard Specification for Solder Metal.
   e. B88, Standard Specification for Seamless Copper Water Tube.
3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
5. International Society of Automation (ISA):
   a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
   b. S5.1, Instrumentation Symbols and Identification.
   c. S5.4, Instrument Loop Diagrams.
   d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
   e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
6. International Conference on Energy Conversion and Application (ICECA).
7. National Electrical Code (NEC).
8. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. ICS 1, Industrial Control and Systems General Requirements.
9. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
10. Underwriters Laboratory, Inc. (UL): 508A, Standard for Safety, Industrial Control Panels.

1.03 DEFINITIONS

A. Abbreviations:

1. FDT: Factory Demonstration Test.
2. HMI: Human-Machine Interface.
3. HVAC: Heating, Ventilating, and Air Conditioning.
4. I&C: Instrumentation and Control.
5. I/O: Input and Output.
6. O&M: Operation and Maintenance.
7. P&ID: Process and Instrument Diagram.
8. PC: Personal Computer.
9. PIC(S): Process Instrumentation and Control System.
10. PLC: Programmable Logic Controller.
11. SCADA: Supervisory Control and Data Acquisition. Includes the existing HMI system, Historian, Webspace server and all components in PLC/RIO cabinets.

B. Enclosure: Control panel, console, cabinet, or instrument housing.

C. Instructor Day: Eight hours of actual instruction time.

D. Standard Software: Software packages that are independent of Project on which they are used. Standard software includes system software, supervisory control, and data acquisition (SCADA) software.

1. System Software: Application independent (non-project specific) software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; network support, programming languages (C, C++, Visual C++, BASIC, Visual Basic, etc.); Office Suites (word processor, spreadsheet, database, etc.); e-mail; security (firewall, antivirus; spam, spyware, etc.) debugging aids; and diagnostics.
2. SCADA Software: Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing configuring and run-time capability for, data acquisition (I/O driver, OPC servers, etc.), monitoring, alarming, human-machine interface, supervisory control, data collection, data retrieval, trending, report generation, control, and diagnostics.
3. Controller Programming Software: Software packages for the configuring of PLCs.

E. Application Software (Programming): Software to provide functions unique to this Project and that are not provided by standard software alone, including but not limited to:

1. Configuring databases, tables, displays, historians, reports, parameter lists, ladder logic, function block, and control strategies required to implement functions unique to this Project.
2. Programming, including HMI and PLC, in any programming or scripting language.

F. Rising/Falling: Define action of discrete devices about their setpoint.

1. Rising: Contacts close when an increasing process variable rises through setpoint.
2. Falling: Contacts close when a decreasing process variable falls through setpoint.

G. Signal Types:

1. Analog Signal, Current Type:
   a. 4 to 20 mA dc signals conforming to ISA S50.1.
   b. Unless otherwise indicated for specific PIC subsection components, use the following ISA S50.1 options.
      1) Transmitter Type: Number 2, two-wire.
      2) Transmitter Load Resistance Capacity: Class L.
      3) Fully isolated transmitters and receivers.
2. Analog Signal, Voltage Type: 1 to 5 volts dc within panel where common high precision dropping resistor is used.
3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
4. Pulse Frequency Signals:
   a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
   b. Pulses generated by contact closures or solid state switches.
   c. Power source less than 30V dc.
5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Complete detailed design of PIC components and PIC drawings.
2. Provide consistent hardware and software functions for PIC. For example, provide functions in control logic, sequence controls, and display layouts in same or similar manner.
3. PIC design as shown and specified includes:
   a. Functional requirements, performance requirements, and Component Specifications.
   b. P&IDs, block diagrams, and network diagrams.
4. Typical drawings for installation details, panel power, and control diagrams.

B. Use a qualified PIC System Integrator for at least the following work:

1. For PIC Equipment and Ancillaries:
   a. Completing detail design.
   b. Submittals.
   c. Equipment, enclosures, and ancillaries.
   d. Instructions, details, and recommendations to, and coordination with Contractor for Certificate of Proper Installation.
   e. Verify readiness for operation.
   f. Verify correctness of final power and signal connections (lugging and connecting).
   g. Adjusting and calibrating.
   h. Starting up.
   i. Testing and coordination of testing.
   j. Training.
2. Verify following Work not by PIC System Integrator is provided:
   a. Correct type, size, and number of signal wires with their raceways.
   b. Correct electrical power circuits and raceways.
   c. Correct size, type, and number of PIC-related pipes, valves, fittings, and tubes.
   d. Correct size, type, materials, and connections of process mechanical piping for in-line primary elements.
3. Non-PIC Equipment Directly Connected to PIC Equipment:
   a. Obtain from Contractor, manufacturers' information on installation, interface, function, and adjustment.
   b. Coordinate with Contractor to allow required interface and operation with PIC.

c. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
d. Test to demonstrate required interface and operation with PIC.
e. Examples of items in this category, but not limited to the following:
    1) Valve operators, position switches, and controls.
    2) Chemical feed pump and feeder speed/stroke controls.
    3) Automatic samplers.
    4) Motor control centers.
    5) Adjustable speed and adjustable frequency drive systems.
f. Examples of items not in this category:
    1) Internal portions of equipment provided under Division 26, Electrical, that are not directly connected to PIC equipment.
    2) Internal portions of package system instrumentation and controls that are not directly connected to PIC equipment.

1.05 SUBMITTALS

A. General:

1. Submit proposed Submittal breakdown consisting of sequencing and packaging of information in accordance with Progress Schedule.
2. Partial Submittals not in accordance with Progress Schedule will not be accepted.
3. Submittal Format:
    a. Electronic Copies: Required for all submittals, unless otherwise noted for specific items.
        1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
        2) Documents created specifically for Project:
            a) Text and Graphics: Microsoft Word.
            b) Lists: Microsoft Excel, unless otherwise noted for specific items.
            c) Drawings: MicroStation or AutoCAD.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists:
    a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, HMI displays, alarm/status logs, and reports.
    b. Use identical abbreviations in PIC subsections.
    c. Submit updated versions as they occur.

6. Activity Completion:
    a. Action Submittals: Completed when reviewed and approved.
    b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.

B. Action Submittals:

1. Bill of Materials: List of required equipment.
    a. Group equipment items by enclosure and field, and within an enclosure, as follows:
        1) PIC Components: By component identification code.
        2) Other Equipment: By equipment type.
    b. Data Included:
        1) Equipment tag number.
        2) Description.
        3) Manufacturer, complete model number and all options not defined by model number.
        4) Quantity supplied.
        5) Component identification code where applicable.
        6) For panels, include panel reference number and name plate inscription.
    c. Formats: Hard copy and Microsoft Excel.
2. Catalog Cuts: I&C components, electrical devices, and mechanical devices:
    a. Catalog information, marked to identify proposed items and options.
    b. Descriptive literature.
    c. External power and signal connections.
    d. Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
3. Component Data Sheets: Data sheets for I&C components.
    a. Format:
        1) Similar to ISA TR20.00.01.
        2) Microsoft Excel, one component per data sheet.
        3) Submit proposed format for Component Data Sheets before completing data sheets for individual components.
    b. Content: Specific features and configuration data for each component, including but not limited to:
        1) Tag Number.
        2) Component type identification code and description.
        3) Location or service.
        4) Service conditions.
        5) Manufacturer and complete model number.
        6) Size and scale range.
        7) Setpoints.

8) Materials of construction.
9) Options included.
10) Power requirements.
11) Signal interfaces.
12) Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.

c. Electronic Copies: Microsoft Excel.

4. Sizing and Selection Calculations:
   a. Primary Elements: Complete calculations plus process data used. Example for Flow Elements: Minimum and maximum values, permanent head loss, and assumptions made.
   b. Controller, Computing, and Function Generating Modules: Actual scaling factors with units and how they were computed.
   c. Electronic Copies: Microsoft Excel, one file for each group of components with identical sizing calculations.
5. Panel Construction Drawings:
   a. Scale Drawings: Show dimensions and locations of panel-mounted devices, doors, louvers, subpanels, internal and external.
   b. Panel Legend (Bill of Material): List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
   c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
   d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
   e. Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.
   f. Submit electronic copies of Drawings.
6. Panel Wiring Diagrams:
   a. Cover wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.
   b. Provide panel wiring diagrams for any existing panels that are to be modified in the field.
   c. Objectives: For use in wiring panels, making panel connections, and future panel trouble shooting.
   d. Diagram Type:
      1) Ladder diagrams where applicable. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.

2) Schematic drawings for wiring of circuits that cannot be well represented by ladder diagrams.

e. Item Identification: Identify each item with attributes listed.
   1) Wires: Wire number and color. Cable number if part of multiconductor cable.
   2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
   3) Components:
      a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
      b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
   4) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
   5) Relay Coils:
      a) Tag number and its function.
      b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
   6) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
   7) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.
f. Show each circuit individually. No "typical" diagrams or "typical" wire lists will be allowed.
g. Ground wires, surge protectors, and connections.
h. Wire and Cable Names: Show names and wire color for circuits entering and leaving a panel. Refer to Division 26, Electrical.

7. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop.
   a. Conform to the minimum requirements of ISA S5.4.
   b. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
   c. Show loop components within a panel and identify each component, component terminals, and panel terminals.

d. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
    1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
    2) Identify the component by tag and description.
    3) Identify panel and component terminal numbers.
e. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
f. Divide each loop diagram into areas for panel face, back-of-panel, field and PLC.
g. Show:
    1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
    2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.

8. Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:
    a. Required voltages, currents, and phases(s). Include calculations and list assumptions.
    b. Maximum heat dissipations Btu per hour. Include calculations and list assumptions.
    c. Maximum permissible internal temperature based on operating range of internal components.
    d. Computed maximum internal temperature. Include calculations and list assumptions. Include the impacts of internal heat generation, solar radiation and shielding.
    e. Use the ambient parameters listed in this section for the applicable service condition.
9. Intrinsic Safety Data: Provide calculations, tables and other data that document entity method application to each circuit using intrinsic safety as a means of dealing with classified area requirements. Include intrinsic safety parameters for devices (maximum voltage allowed, maximum current allowed, internal capacitance, internal inductance, etcetera) and barriers (open circuit voltage, short circuit current, allowed capacitance, and allowed inductance) for all devices in all circuits. This shall include parameters for all components provided by the PICS supplier and all others working on Project.
10. Panel Plumbing Diagrams: For each panel containing piping and tubing. Show type and size for:
    a. Pipes and Tubes: Thickness, pressure rating, and materials.
    b. Components: Valves, regulators, and filters.

c. Connections to panel-mounted devices.
d. Panel interface connections.
e. Submit electronic copies of Drawings.

11. Installation Details: Include modifications or further details required and define installation of I&C components.
12. Spares, expendables, and test equipment.
    a. Electronic Copies: Microsoft Excel.
13. Applications Software Documentation:
    a. Complete configuration documentation for microprocessor based programmable devices.
    b. For each device, include program listing and function block diagrams, as appropriate, showing:
        1) Functional block or modules used.
        2) Configuration, calibration, and tuning parameters.
        3) Descriptive annotations included in PLC programming describing purpose and function of each block of programming.
14. For existing control panels being modified, the Shop Drawings shall depict all existing components, new components, and components being demolished or modified. The Drawings shall use a consistent method of differentiating new, existing, modified, and demolished components and wires.

C. Informational Submittals:

1. PICS Schedule of Values:
    a. Upon acceptance by Engineer, incorporate in Contractor's Schedule of Values specified in Section 01 29 00, Payment Procedures.
    b. Incorporate proposed Submittal breakdown.
    c. Refer to Example PICS Items for Schedule of Values referenced in Article Supplements.
2. PICS Progress Schedule:
    a. Upon acceptance by Engineer, incorporate in Contractor's Detailed Progress Schedule specified in Section 01 32 00, Construction Progress Documentation.
    b. Incorporate proposed Submittal breakdown.
    c. Refer to Example Entries for PICS Items for Progress Schedule referenced in Article Supplements.

3. Operation and Maintenance Data: In accordance with Section 01 78 23, Operation and Maintenance Data, and in addition the following:
    a. General:
        1) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PIC components.
        2) Submittal Format: Electronic copies for all submittals. Refer to Article Submittals, heading Submittal Format.
    b. Final versions of Legend and Abbreviation Lists.
    c. Process and Instrumentation Diagrams: Marked up copy of revised P&ID to reflect as-built PIC design.
    d. Provide the following items as defined under heading Action Submittals:
        1) Bill of materials.
        2) Catalog cuts.
        3) Instrument list.
        4) Component data sheets.
        5) Detailed Wiring Diagrams: As-Built Drawings.
            a) Panel wiring diagrams.
            b) Loop diagrams.
            c) Interconnecting wiring diagrams.
        6) Panel plumbing diagrams.
        7) Applications software documentation including final versions of all PLC and HMI programming.
    e. Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
        1) Content for Each O&M Manual:
            a) Table of Contents.
            b) Operations procedures.
            c) Installation requirements and procedures.
            d) Maintenance requirements and procedures.
            e) Troubleshooting procedures.
            f) Calibration procedures.
            g) Internal schematic and wiring diagrams.
        2) Provide PDF file will be linked index to all manuals.
    f. List of spares, expendables, test equipment and tools provided.
    g. List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.
4. Provide Manufacturer's Certificate of Proper Installation where specified.

5. Testing Related Submittals:
    a. Factory Demonstration Test:
        1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
        2) Final Test Procedures:
            a) Proposed test procedures, forms, and checklists.
            b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
        3) Test Documentation: Copy of signed off test results.
    b. Functional Test:
        1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
        2) Final Test Procedures: Proposed test procedures, forms, and checklists.
        3) Test Documentation:
            a) Copy of signed-off test results.
    c. Performance Test:
        1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
        2) Final Test Procedures: Proposed test procedures, forms, and checklists.
        3) Test Documentation: Copy of signed off test results.
6. Owner Training Plan: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.06 QUALITY ASSURANCE

A. Qualifications: PIC System Integrator shall be selected from one of the following (listed alphabetically):

1. Automation Control Service (ACS):
   Address: 6281 Technology Drive | Pensacola, FL 32505.
   Phone: (850) 477-8440
   Contact: Kenneth Faul, ken.faul@autoconserv.com

2. Prime Controls:
   Address: 1725 Lakepointe Drive, Lewisville, TX 75057.
   Phone: (815) 382-8389
   Contact: AJ Gezunterman, a.gezunterman@prime-controls.com

3. Revere Control Systems:
   Address: 2240 Rocky Ridge Road, Birmingham, AL 35215.
   Phone: 1-800-536-2525
   Contact: Nan Johnson, njohnson@reverecontrol.com

4. Tesco Controls:
   Address: Bluebonnet Blvd. Ste B, Baton Rouge, LA 70809-9639.
   Phone: (916) 395-8800
   Contact: Richard Ercolini, rercolini@tescocontrols.com

B. PIC Coordination Meetings:

1. PIC Schedule Coordination Meeting:
   a. Purpose: Discuss Engineer's comments and resolve scheduling issues.
2. Startup and Training Meeting:
   a. Purpose:
      1) Startup and testing planning.
      2) Resolve required changes to proposed training plan.
      3) Identify specific Owner personnel to attend training.

1.07 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

D. Cover panels and other elements that are exposed to dusty construction environments.

1.08 SEQUENCING AND SCHEDULING

A. Prerequisite Activities and Lead Times: Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:

1. PICS Kickoff Meeting Prerequisite: Schedule of Values and Progress Schedule submitted and reviewed.
2. Shop Drawing Reviews by Engineer:
   a. Prerequisite: Engineer acceptance of Schedule of Values and Progress Schedule.

3. Test Prerequisite: Associated test procedures Submittals completed.
4. PICS Startup and Testing Meeting Prerequisite:
   a. Factory Demonstration Test Complete.
   b. Engineer review of preliminary training plan and prior to Functional Test.
5. Training Prerequisite: Associated training plan Submittal completed.
6. Unwitnessed Factory Demonstration Test Prerequisite: Related Shop Drawings approved.
7. PLC and HMI Shipment to Site:
   a. General Prerequisites:
      1) Approval of PIC Shop Drawings and preliminary operation and maintenance data.
      2) Unwitnessed FDT complete.
8. PLC and HMI Installation Prerequisite: Equipment received at Site.
9. Functional Test Prerequisite: PICS Startup and Testing Meeting complete.
10. Performance Test Prerequisite: Functional Test completed and facility started up.

B. Partial Payment Limits and Milestone Payment Breakdown:

1. Requests for partial payment shall be considered providing:
   a. Milestone activity is completed in accordance with criteria specified herein.
   b. Prerequisite activities are completed with criteria specified herein.
2. Limits:
   a. Administrative and Shop Drawing Submittals: 20 percent, maximum.
   b. Factory Demonstration Test: 5 percent, minimum.
   c. Performance Test: 15 percent, minimum.
   d. PICS O&M Manuals: 3 percent, minimum.

1.09 EXTRA MATERIALS

A. As specified in PIC subsections.

B. In computing spare parts quantities based on specified percentages, round up to nearest whole number.

C. Spare Parts: As noted in Section 40 99 90, Package Control Systems.

D. Expendables: For following items provide manufacturer's recommended 2-year supply, unless otherwise noted.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide PIC functions shown on Drawings and required in PIC subsections for each system and loop. Furnish equipment items required in PIC subsections. Furnish materials, equipment, and software, whether indicated or not, necessary to effect required system and loop performance.

B. First Named Manufacturer: PIC design is based on first named manufacturers of equipment, materials, and software.

1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with the General Conditions, Article 6.05 Substitutes and "Or-Equals".
2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.

C. Like Equipment Items:

1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
2. Implement same or similar functions in same or similar manner. For example control logic, sequence controls, and display layouts.

2.02 I&C COMPONENTS

A. Components for Each Loop: Major components for each loop are listed in Instrument List referenced in Article Supplements. Furnish equipment that is necessary to achieve required loop performance.

B. Control Panels: Reference Control Panel Schedule in Paragraph Supplements.

C. Specifications: Refer to Section 40 91 00, Instrumentation and Control Components, for specifications for I&C components.

D. PLC Sequencing: Modifications to the plant control system shall be performed in such a way to limit downtime of the existing plant control system and loss of field I/O.

1. Sampler may not be unwired or moved until the new location is ready with power and field wiring.
2. FP-12-1 may not be abandoned or unwired from CP-16-3 until piping has been demolitioned between the FIT-12-1 flowmeter and the existing Barscreen. LSHH-12-2 shall be rewired at that time to pass through FP-12-1 to CP-16-3.

2.03 SERVICE CONDITIONS

A. Standard Service Conditions: The following defines certain types of environments. PIC subsections refer to these definitions by name to specify the service conditions for individual equipment units. Design equipment for continuous operation in these environments:

1. Outside:
   a. Temperature: 20 degrees F to 104 degrees F.
   b. Relative Humidity: 10 percent to 100 percent, rain.
   c. NEC Classification: Nonhazardous.
2. Outside, Corrosive:
   a. Temperature: 20 degrees F to 104 degrees F.
   b. Relative Humidity: 0 to 100 percent, rain.
   c. Corrosive Environment: Hydrogen sulfide gas.
   d. NEC Classification: Nonhazardous.

B. Standard Service Conditions for Panels and Consoles: Unless otherwise noted, in Instrument List and Control Panel Schedule located in Article Supplements at End of Section, design equipment for continuous operation in these environments:

1. Smaller Panels and Assemblies (that are not freestanding):
   a. Inside, Air Conditioned: NEMA 12.
   b. All Other Locations: NEMA 4X.
2. Field Elements: Outside.

2.04 NAMEPLATES AND TAGS

A. Safety-Related Nameplates: As required by applicable codes and standards including NFPA 79 and UL 508A.

1. Provide a warning nameplate on all control panel enclosures with circuits with more than one electrical supply. For example, any panel with dry contacts in a circuit powered elsewhere.

B. Panel Nameplates: Enclosure identification located on enclosure face.

1. Materials: Laminated plastic attached to panel with stainless steel screws.
2. Letters: 1/2-inch high, white on black background, unless otherwise noted.

C. Component Nameplates, Panel Face: Component identification located on panel face under or near component.

1. Location and Inscription: As shown on Panel Drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

D. Component Nameplates, Back of Panel: Component identification located on or near component inside of enclosure.

1. Inscription: Component tag number.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

E. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.

1. Inscription:
   a. Refer to table under Paragraph Standard Pushbutton Colors and Inscriptions.
   b. Refer to table under Paragraph Standard Light Colors and Inscriptions.
   c. Refer to P&IDs on Drawings.
2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
3. Letters: Black on gray or white background.

F. Service Legends: Component identification nameplate located on face of component.

1. Inscription: As shown on panel drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

G. Nametags: Component identification for field devices.

1. Inscription: Component tag number.
2. Materials: 16-gauge, Type 304 stainless steel.
3. Letters: 3/16-inch high, imposed.
4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire or stainless steel screws.

2.05 MECHANICAL SYSTEM COMPONENTS

A. Reference Section 40 91 00, Instrumentation and Control Components.

2.06 FUNCTIONAL REQUIREMENTS FOR CONTROL LOOPS

A. Shown on Drawings, in panel control diagrams, and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.

B. Supplemented by Loop Specifications that describe requirements not obvious on P&IDs. See Article Supplements located at End of Section.

2.07 ELECTRICAL REQUIREMENTS

A. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

B. Wiring External to PIC Equipment:

1. Special Control and Communications Cable: Provided by PIC System Integrator as noted in Component Specifications and PIC subsections.
2. Other Wiring and Cable: As specified in Section 26 05 05, Conductors.

C. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

D. Wires within Enclosures:

1. ac Circuits:
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current to be carried, but not less than No. 18 AWG.
2. Analog Signal Circuits:
   a. Type: 600-volt stranded copper, twisted shielded pairs or triad with a 100 percent, aluminum-polyester shield, rated 60 degrees C.
   b. Panels with Circuits Less Than 600 volts: Rated at 600 volts. Belden No. 18 AWG Type 9341, Triad Beldon No. 1121A.
   c. Size: No. 18 AWG, minimum.

3. Other dc Circuits.
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current carried, but not less than No. 18 AWG.
4. Special Signal Circuits: Use manufacturer's standard cables.
5. Wire Identification: Numbered and tagged at each termination.
   a. Wire Tags: Machine printed, heat shrink.
   b. Manufacturers:
      1) Brady Perma Sleev.
      2) Tyco Electronics.

E. Terminate and identify wires entering or leaving enclosures as follows:

1. Analog and discrete signal, terminate at numbered terminal blocks.
2. Special signals terminated using manufacturer's standard connectors.
3. Identify wiring in accordance with requirements in Section 26 05 05, Conductors.

F. Terminal Blocks for Enclosures:

1. Quantity:
   a. Accommodate present and spare indicated needs.
   b. Wire spare PLC I/O points to terminal blocks.
   c. One wire per terminal for field wires entering enclosures.
   d. Maximum of two wires per terminal for No. 18 AWG wire for internal enclosure wiring.
   e. Spare Terminals: 20 percent of connected terminals, but not less than 5 per terminal block, unless otherwise shown on Drawings.
2. Terminal Block Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Paragraph Electrical Components.

G. Grounding of Enclosures:

1. Furnish isolated copper grounding bus for signal and shield ground connections.
2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
3. Single Point Ground for Each Analog Loop:
   a. Locate signal ground at dc power supply for loop.
   b. Use to ground wire shields for loop.
4. Ground terminal block rails to ground bus.

H. Analog Signal Isolators:

1. Furnish signal isolation for analog signals that are sent from one enclosure to another.
2. Do not wire in series instruments on different panels, cabinets, or enclosures.

I. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.

1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

J. Electrical Transient Protection:

1. General:
   a. Function: Protect elements of PIC against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
   b. Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show in Shop Drawings. Refer to example wiring in installation details in Drawings.
   c. Provide, install, coordinate, and inspect grounding of surge suppressors at:
      1) Connection of ac power to PIC equipment including panels, consoles assembles, and field-mounted analog transmitters and receivers.
      2) At the field of all analog signal circuits.
      3) At the panel, console, or assembly of all analog signal circuits.
      4) In the panel for all spare analog inputs and outputs.
2. Surge Suppressor Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Surge Suppressors.
3. Installation and Grounding of Suppressors:
   a. As shown. See Surge Suppressor Installation Details.
   b. Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.

2.08 PANEL FABRICATION

A. General:

1. Nominal Panel Dimensions: Refer to Control Panel Schedule in Article Supplements for maximum external dimensions allowed for individual control panels.
2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.

3. Fabricate panels, install instruments and wire, and plumb at panel builder's facility. No fabrication other than correction of minor defects or minor transit damage permitted onsite.
4. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.
5. Electrical Work: In accordance with the applicable requirements of Division 26, Electrical.

B. Temperature Control:

1. Cooling: Design panels to maintain components within rated operating temperature range. Include required cooling components.
   a. Ventilated Panels:
      1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel and on panel.
      2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
      3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
      4) Louver Construction: Stamped sheet metal.
      5) Ventilation Fans:
         a) Furnish where required to provide adequate cooling.
         b) Create positive internal pressure within panel.
         c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
      6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
   b. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with a combination of natural convection, shielding or forced ventilation.
2. Space Heaters:
   a. Hygrostatically controlled to maintain internal panel temperatures above dewpoint. Mechanical hygrostat by Hoffman, Model AMHUM.
   b. Required for all outdoor control panels.

C. Nonfreestanding Panel Construction:

1. Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Control Panel Schedule in Article Supplements:
   a. Panels listed as inside, air conditioned:
      1) Enclosure Type: NEMA 12.
      2) Materials: Steel.

b. Other Panels:
1) Enclosure Type: NEMA 4X.
2) Materials: Type 304 stainless steel.

2. Metal Thickness: 14-gauge, minimum.
3. Doors:
a. Gasket: Rubber-gasketed with continuous hinge.
b. Latches: Three-point, NEMA 4X rated.
c. Handles: Padlockable.
d. Hinges: Full length, continuous, piano type with stainless steel pin.
4. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels:
a. Manufacturer and Product:
1) Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.
2) Hoffman; H2Omit Stainless Steel Vent Drain.
5. Manufacturers:
a. Hoffman Engineering Co.
b. H. F. Cox.

D. Control Panel Electrical:

1. Power Distribution within Panels:
a. Feeder Circuits:
1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
2) Make provisions for feeder circuit conduit entry.
3) Furnish terminal block for termination of wires.
b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.
1) Locate to provide clear view of and access to breakers when door is open.
2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker, but not trip main breaker.
a) Branch Circuit Breakers: 15 amps at 250V ac.
3) Provide UL 489 listed breakers.
4) Breaker Manufacturers and Products:
a) Square D; Multi 9 Series.
b) Allen-Bradley; 1489-A Series.
c) Or approved equal.
c. Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:
1) Devices on Single Circuit: 20, maximum.
2) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.

3) Branch Circuit Loading: 12 amperes continuous, maximum.
4) Panel Lighting and Service Outlets: Put on separate 15 amp, 120V ac branch circuit.
5) Provide 120V ac plugmold for panel components with line cords.

2. Signal Distribution:
   a. Signal Wiring: Separate analog signal cables from power and control within a panel and cross at right angles where necessary.
   b. Within Panels: 4 to 20 mA dc signals may be distributed as 1V dc to 5V dc.
   c. Outside Panels: Isolated 4 to 20 mA dc only.
   d. Signal Wiring: Twisted shielded pairs.
   e. RTD and Thermocouple Extension Cable:
      1) Continuous field to panel with no intermediate junction boxes or terminations.
      2) RTDs in motor windings are considered a 600-volt circuit.
      3) Terminate thermocouple extension wire directly to loop instrument.
3. Signal Switching:
   a. Use dry circuit type relays or switches.
   b. No interruption of 4 to 20 mA loops during switching.
   c. Switching Transients in Associated Signal Circuit:
      1) 4 to 20 mA dc Signals: 0.2 mA, maximum.
      2) 1V dc to 5V dc Signals: 0.05V, maximum.
4. Relay Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Article Electrical Components.
5. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
6. Internal Panel Lights for Freestanding Panels:
   a. Type: Switched LED lighting package.
   b. Quantity: One light for every 4 feet of panel width.
   c. Life Expectancy: Minimum 60,000 hours at 68 degrees F.
   d. Mounting: Inside and in the top of back-of-panel area.
   e. Manufacturer and Product: Hoffman PaneLite series, or equal.
7. Service Outlets for Freestanding Panels:
   a. Type: Three-wire, 120-volt, 15-ampere, GFCI duplex receptacles. Provide non-GFCI receptacles for panels fed from GFI breakers.
   b. Quantity:
      1) Panels 4 Feet Wide and Smaller: One.
      2) Panels Larger than 4 Feet Wide: One for every 4 feet of panel width, two minimum per panel.
   c. Mounting: DIN Rail mounted evenly spaced along back-of-panel area.

8. Internal Panel Lights and Service Outlets for Smaller Panels:
   a. Internal Panel Light: Switched LED lighting package.
   b. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI duplex receptacle. Provide non-GFCI receptacles for panels fed from GFI breakers.
   c. Manufacturer and Product: Hoffman PaneLite series, or equal.
   d. Required for panels. Refer to Control Panel Schedule in Article Supplements.
9. Standard Pushbutton Colors and Inscriptions:
   a. Use following unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

   b. Lettering Color:
      1) Black on white and yellow buttons.
      2) White on black, red, and green buttons.
10. Standard Light Colors and Inscriptions:
   a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
ON	ON	Green
OFF	OFF	Red
OPEN	OPEN	Green

Tag Function	Inscription(s)	Color
CLOSED	CLOSED	Red
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

b. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

E. PIC Enclosure Internal Wiring:

1. Restrain by plastic ties or ducts or metal raceways.
2. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
4. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
5. Connections to Screw Type Terminals:
   a. Locking-fork-tongue or ring-tongue lugs.
   b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
   c. Wires terminated in a crimp lug, maximum of one.
   d. Lugs installed on a screw terminal, maximum of two.
6. Connections to Compression Clamp Type Terminals:
   a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
   b. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
9. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.

10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
11. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.
12. Conductor Color Coding: In accordance with UL508A.
13. Conductors Carrying Foreign Voltages within a Panel:
    a. Route foreign voltage conductors into panel and land on a circuit blade disconnect type terminal block.
    b. Use wire with pink insulation to identify foreign voltage circuits within panel from terminal block on. Do not use wires with pink insulation for any other purpose.
14. Harness Wiring:
    a. 120V ac: No. 14 AWG, MTW.
    b. 24V dc: No. 16 AWG, MTW where individual conductors are used and Type TC shielded tray cable where shielded wire is used.
15. Panelwork:
    a. No exposed connections.
    b. Allow adjustments to equipment to be made without exposing these terminals.
    c. For power and control wiring operating above 80V ac or dc use covered channels or EMT raceways separate from low voltage signal circuits.
16. Plastic Wire Ducts Color:
    a. 120V ac: White.
    b. 24V dc: Gray.
    c. Communications Cables and Fiber Optic Jumpers: Orange.
17. Provide a communications plastic wire duct for communications cables and fiber optic cables between the communications devices in control panel and communications raceways. Design plastic wire duct design to take into account the minimum bending radius of the communications cable.
18. Make plastic wire ducts the same depth.
19. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.

F. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.

G. Factory Finishing:

1. Furnish materials and equipment with manufacturer's standard finish system in accordance with Section 09 90 00, Painting and Coating.

2. Use specific color if indicated. Otherwise use manufacturer's standard finish color, or light gray if manufacturer has no standard color.
3. Stainless Steel and Aluminum:
   a. Inside: Not painted.
   b. Outside in direct sunlight: 0.125-inch marine grade aluminum with white polyester coat finish.

2.09 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsules:

1. Areas Where Required: Refer to Part 3, Paragraph Protection.
2. Manufacturers and Products:
   a. Northern Instruments; Model Zerust VC.
   b. Hoffmann Engineering; Model A-HCI.

2.10 SOURCE QUALITY CONTROL

A. General:

1. Engineer may actively participate in many of the tests.
2. Engineer reserves right to test or retest specified functions.
3. Engineer's decision will be final regarding acceptability and completeness of testing.
4. Procedures, Forms, and Checklists:
   a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
   b. Describe each test item to be performed.
   c. Have space after each test item description for sign off by appropriate party after satisfactory completion.
5. Required Test Documentation: Test procedures, forms, and checklists signed by Engineer and Contractor.
6. Conducting Tests:
   a. Provide special testing materials and equipment.
   b. Wherever possible, perform tests using actual process variables, equipment, and data.
   c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
   d. Define simulation techniques in test procedures.
   e. Test Format: Cause and effect.
      1) Person conducting test initiates an input (cause).
      2) Specific test requirement is satisfied if correct result (effect), occurs.

B. Unwitnessed Factory Test:

1. Scope: Inspect and test PIC to ensure it is operational, ready for FDT.
2. Location: PIC System Integrator's facility.
3. Integrated Test:
   a. Interconnect and test PIC, except for primary elements and smaller panels.
   b. Exercise and test functions.
   c. Provide stand-alone testing of smaller panels.
   d. Simulate inputs and outputs for primary elements, final control elements, and panels excluded from test.
   e. New servers and workstations shall be used in testing.

C. Factory Demonstration Tests (FDT): Not required.

PART 3 EXECUTION

3.01 EXAMINATION

A. For equipment not provided by PIC System Integrator, but that directly interfaces with PIC, verify the following conditions:

1. Proper installation.
2. Calibration and adjustment of positioners and I/P transducers.
3. Correct control action.
4. Switch settings and dead bands.
5. Opening and closing speeds and travel stops.
6. Input and output signals.

3.02 INSTALLATION

A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Engineer.

B. Wiring connected to PIC components and assemblies, including power wiring in accordance with requirements in Section 26 05 05, Conductors.

C. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

D. Mechanical Systems:

1. Copper and Stainless Steel Tubing Support: Continuously supported by aluminum tubing raceway system.
2. Plastic Tubing Support: Except as shown on Drawings, provide continuous support in conduit or by aluminum tubing raceway system.

3. Install conduit for plastic tubing and tubing raceways parallel with, or at right angles to, structural members of buildings. Make vertical runs straight and plumb.
4. Tubing and Conduit Bends:
    a. Tool-formed without flattening, and of same radius.
    b. Bend Radius: Equal to or larger than conduit and tubing manufacturer's recommended minimum bend radius.
    c. Slope instrument connection tubing in accordance with installation details.
    d. Do not run liquid filled instrument tubing immediately over or within a 3-foot plan view clearance of electrical panels, motor starters, or mechanical mounting panel without additional protection. Where tubing must be located in these zones, shield electrical device to prevent water access to electrical equipment.
    e. Straighten coiled tubing by unrolling on flat surface. Do not pull to straighten.
    f. Cut tubing square with sharp tubing cutter. Deburr cuts and remove chips. Do not gouge or scratch surface of tubing.
    g. Blow debris from inside of tubing.
    h. Make up and install fittings in accordance with manufacturer's recommendations. Verify make up of tube fittings with manufacturer's inspection gauge.
    i. Use lubricating compound or TFE tape on stainless steel threads to prevent seizing or galling.
    j. Run tubing to allow but not limited to, clear access to doors, controls and control panels; and to allow for easy removal of equipment.
    k. Provide separate support for components in tubing runs.
    l. Supply expansion loops and use adapters at pipe, valve, or component connections for proper orientation of fitting.
    m. Keep tubing and conduit runs at least 12 inches from hot pipes.
    n. Locate and install tubing raceways in accordance with manufacturer's recommendations. Locate tubing to prevent spillage, overflow, or dirt from above.
    o. Securely attach tubing raceways to building structural members.
5. Enclosure Lifting Rings: Remove rings following installation and plug holes.

E. Field Finishing: Refer to Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. General:

1. Coordinate PIC testing with Owner and affected Subcontractors.
2. Notify Engineer of Performance Test schedule 4 weeks prior to start of test.
3. Engineer may actively participate in tests.
4. Engineer reserves right to test or retest specified functions.
5. Engineer's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:

1. Require PIC System Integrator to observe PIC equipment installation to extent required in order to provide Certificates of Proper Installation.
2. Require PIC site representative to supervise and coordinate onsite PIC activities.
3. Require PIC site representative to be onsite while onsite work covered by this section and PIC subsystems is in progress.

C. Leak Tests: During preparation for testing, conduct leak tests in accordance with Section 40 80 01, Process Piping Leakage Testing.

D. Testing:

1. Prior to Facility Startup and Performance Evaluation period for each facility, inspect, test, and document that associated PIC equipment is ready for operation.
2. Functional Test: Performed by PIC System Integrator to test and document PIC is ready for operation.
    a. Loop/Component Inspections and Tests:
        1) These inspections and tests will be spot checked by Engineer.
        2) Check PIC for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
    b. Unwitnessed FDT-Repeat:
        1) Repeat Unwitnessed FDT onsite with installed PIC equipment and software.
        2) As listed in PIC subsections, certain portions of Unwitnessed FDT may not require retesting.
        3) Use Unwitnessed FDT test procedures as basis for this test.
        4) In general, this test shall not require witnessing. However, portions of this test, may be witnessed.

E. Performance Test During and After Facility Startup:

1. Once a facility's Functional Test has been completed and that facility has been started up, perform jointly with Owner's Consultant a Performance Test on associated PIC equipment to demonstrate that it is operating as required by Contract Documents. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
2. Loop-specific and nonloop-specific tests same as required for FDT except that entire installed PIC tested using actual process variables and functions demonstrated.
3. Perform local and manual tests for each loop before proceeding to remote and automatic modes.
4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
5. Make updated versions of documentation required for Performance Test available to Engineer at Site, both before and during tests.
6. Make O&M data available to Engineer at Site both before and during testing.
7. Follow daily schedule required for FDT.
8. Determination of Ready for Operation: When Functional Test has been completed.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: As required by each PIC subsection.

B. See section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 TRAINING

A. General:

1. Provide an integrated training program for Owner's personnel.
2. Perform training to meet specific needs of Owner's personnel.
3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.

4. Provide instruction on two working shift(s) as needed to accommodate the Owner's personnel schedule.
5. Provide a video recording of all training sessions in a format acceptable to the Owner.
    a. Owner reserves the right to reuse video of training sessions.

B. Operations and Maintenance Training:

1. General:
    a. Refer to specific requirements specified in PIC Subsections.
    b. Include review of O&M data and survey of spares, expendables, and test equipment.
    c. Use equipment similar to that provided.
    d. Unless otherwise specified in PIC subsections, provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.
2. Operations and Maintenance Training: For Owner's operations personnel on operation of I&C components.
    a. Training Session Duration: 1/2 instructor day.
    b. Number of Training Sessions: Two.
    c. Location: Project Site.
    d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis. Develop skills needed for routine maintenance of PIC.
    e. Content: Conduct training on loop-by-loop basis.
        1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
        2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
        3) Interfaces with PIC subsystems.
        4) Component calibration.
        5) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
        6) Troubleshooting and diagnosis for equipment and software.
        7) Replacing lamps, chart paper, and fuses.
        8) I&C components removal and replacement.
        9) Periodic preventive maintenance.

3.06 CLEANING

A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.07 PROTECTION

A. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.

B. Periodically replace capsules based on capsule manufacturer's recommendations.

3.08 SUPPLEMENTS

A. Supplements listed below, follows "End of Section," are part of this Specification.

1. Loop Descriptions.
2. PLC Input/Output List.
3. Instrument List.

END OF SECTION

LOOP DESCRIPTIONS

Note(s):

1. This document does not describe every function required by the Contract Documents. Rather, it supplements and clarifies the functions required by the P&IDs and panel wiring diagrams.

2. Also refer to Supplement 2 I/O List.

ALARMS

Display all alarms shown on the P&IDs and I/O List, including any existing alarms.

STATUS MONITORING

Display all status signals shown on the P&IDs and I/O List. Examples include hand switch in Auto; pump X ON status; pump fail, etc.

UNIT PROCESSES

A. 08-N-602 – Headworks Influent Flow, FE/FIT-12-21

1. General: The existing Magnetic flowmeter FE/FIT-12-1 shall be abandoned in place and the new Doppler flowmeter FE/FIT-12-21 shall be used. The existing flowmeter may be reinstated on a future Headworks project. Provide a logic switch in the HMI as a protected control point to allow an authorized Supervisor to toggle between the old and new flow signals. When the switch is set to "Magmeter", all PLC logic and HMI displays will utilize FE/FIT-12-1 for control, monitoring, and totalization. When the switch is set to "Doppler", all PLC logic and HMI displays will utilize FT/FIT-12-21 instead. If the scaled range of the Doppler flow is different from the Magmeter flow, update the scaling in the PLC using the same HMI toggle switch.

B. 08-N-602 – Headworks Drum Screen, FP-12-3 (Vendor Packaged Panel)

1. General: The Drum Screen is designed to remove solids from the Influent Wastewater at the beginning of the Headworks and dispose of them in a screenings dumpster.
2. AUTO Operation: AUTO mode status signal shall be hardwired to CP-16-3.
3. When LSH-12-22 or E-STOP are active, the status shall be hardwired to CP-16-3 as a single General Fail Alarm.
4. In any mode of operation, the motor Run Status shall be sent to CP-16-3 as a hardwired signal.

C. 08-N-602 – Influent Sampler, M-12-19 (Relocated)

1. General: The existing Influent Sampler is designed to take periodic samples of the Influent Wastewater at the beginning of the Headworks for Lab sampling.
2. Normal Operation: A Flow-Proportional composite sample is collected automatically based on pre-programmed configuration of the unit. The existing Flow Pace signal is hardwired to the Sampler.
3. Alarm: In the event of a Sampler failure, a discrete output signal will be activated and displayed on the plant HMI.
4. The existing Flow Rate and Sampler Fail Alarm will be reterminated in CP-16-3. Modify location on HMI graphics if necessary to match P&ID location.

END OF LOOP DESCRIPTIONS

I/O LIST

PLC	Drawing	Tag	Function/Description	DI	DO	AI	AO	Comment
CP-16-3	08-N-602	FC-12-1	HEADWORKS FLOW RATE TO SAMPLER *(FLOW RATE)*				1	Existing PLC/HMI signals allocated
CP-16-3	08-N-602	M-12-19-FA	HEADWORKS SAMPLER FAIL ALARM *(FA)*	1				Existing PLC/HMI signals allocated
CP-16-3	08-N-602	M-12-17-YS	DRUM SCREEN RUN STATUS *(YS)*	1				Existing PLC/HMI signals allocated
CP-16-3	08-N-602	M-12-17-XA	DRUM SCREEN HIGH LEVEL / ESTOP / FAIL ALARM *(FA)*	1				Existing PLC/HMI signals allocated
CP-16-3	08-N-602	M-12-17-HOA:AUTO	DRUM SCREEN HOA SWITCH IN AUTO *(AUTO)*	1				Existing PLC/HMI signals allocated
	08-N-602	FIT-12-21	HEADWORKS INFLUENT FLOW			1		New Signal. Retain original FIT-12-1 input for future use.
			CP-16-3 (Existing Panel modified by PICS)	4	0	1	1	ONLY NEW SIGNALS OR SIGNALS REQUIRING RETERMINATION AT THIS PANEL HAVE BEEN LISTED.
			,					

INSTRUMENT LIST

TAG	QTY	COMP CODE	COMPONENT TITLE	OPTIONS	P&ID	Inst. Detail
FE/FIT-12-21	1	F134	FLOW ELEMENT AND TRANSMITTER, ULTRASONIC, DOPPLER	Pipe Size: 16" Pipe Type/Liner: Confirm with Contractor Media: Raw Wastewater Velocity: 3.2 ft/sec Scale Range: 0-2.5 MGD. Process Range: To match existing FIT-12-1 range in PLC.	08-N-602	4091-209

SECTION 40 91 00
INSTRUMENTATION AND CONTROL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section gives general requirements for instrumentation and control components.

PART 2 PRODUCTS

2.01 GENERAL

A. Article Mechanical Systems Components covers requirements of mechanical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.

B. Article Electrical Components covers requirements for electrical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.

C. All other Part 2 articles cover components that are referenced by Instrument Lists or Data Sheets in Section 40 90 00, Instrumentation and Control for Process Systems, or by specific component numbers in other PIC subsections.

D. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MECHANICAL SYSTEMS COMPONENTS

A. Flow Element, Rotameter, Purge:

1. For air or water service, unless otherwise noted.
2. Materials: Glass tube, fiberglass body, stainless steel float, nylon ball check valve.

3. Direct-Reading Scale Length: 2-1/2 inches, minimum.
4. Scale Ranges: 0 scfh to 2.5 scfh for air service or 0 gph to 10 gph for water service.
5. Integral inlet needle valves.
6. Integral differential pressure regulators:
   a. For water service.
   b. For air service for level ranges greater than 10 feet of water.
7. Rotameters for water service.
8. Manufacturers and Products:
   a. Fischer & Porter; Series 10A3130.
   b. Brooks; Series DS-1350.

B. Manifold, Three-Valve Equalizing:

1. Type: For isolation and equalization of differential pressure transducers.
2. Materials: Stainless steel.
3. Manufacturers and Products:
   a. Anderson, Greenwood and Co.; Type M1.
   b. Evans.

C. Pressure Gauge: For other than process variable measurement.

1. Dial Size: Nominal 2-inch dial size.
2. Accuracy: 2 percent of span.
3. Scale Range: Such that normal operating pressure lies between 50 percent and 80 percent of scale range.
4. Connection: 1/4-inch NPT through bottom, unless otherwise noted.
5. Manufacturers and Products:
   a. Ashcroft Utility; Gauge Series 1000.
   b. Marsh; Standard Gauge Series.
   c. Ametek U.S.; Gauge Series P500.
   d. Acculite; Series 2000.

D. Valve, Needle:

1. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
2. Size: 0.020-inch orifice.
3. Manufacturers and Products:
   a. Whitey; Model 21RF2.
   b. Hoke; 3700 Series.

E. ON/OFF Valves:

1. Type: Ball valve.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
    a. Whitey; Series 41 through Series 43.
    b. Hoke; Flomite 7100 Series.

F. Regulating Valves:

1. Type: Needle valves, with regulating stems and screwed bonnets.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
    a. Whitey; Catalog No. RF or No. RS.
    b. Hoke; 3100 through 3300 Series.

G. Valve, Three-Way:

1. Type: Ball valve.
2. Materials: Brass or stainless steel with nylon handle as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
    a. Whitey; Series 41 through Series 43.
    b. Hoke; Selecto-Mite Series.

H. Valve, Four-Way:

1. Type: Four-way, two-position ball valve.
2. Materials:
    a. Body and Stem: Type 316 stainless steel.
    b. Handle: Black nylon.
    c. Packing Gland: Teflon.
3. Ball and stem bed, one-piece assembly.
4. Machined handle stops and directional nameplates.
5. Manufacturers and Products:
    a. Whitey; Series 457.
    b. Hoke; Multi-Mite Series.

I. Spool Valve:

1. Type: Five-port arrangement as shown, two-position, push-to-operate knob attached to the spool stem, and spring return.
2. Materials: Aluminum construction with Teflon impregnated aluminum spool, stainless steel spring, and Buna-N O-rings.
3. Port Connection: 1/4-inch outside diameter tube fittings.
4. Manufacturer and Product: Norgren; T71DAOO-TSO-TKO.

J. Solenoid Valve, Two-Way:

1. Type: Globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation.
2. Materials:
   a. Body: Brassed or stainless steel globe valves as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
   b. Valve Seat: Buna-N.
3. Size: Normally closed or opened, as noted.
4. Coil: 115V ac, unless noted otherwise.
5. Solenoid Enclosure: NEMA 4.
6. Manufacturer and Product: ASCO; Red Hat Series 8260.

K. Pressure Regulator, Air:

1. Provide air at reduced pressures, as shown, constant to within plus or minus 10 percent for flows from 0 scfh to 300 scfh with 100 psi supply pressure.
2. Setscrew for outlet pressure adjustment.
3. Integral filter and relief valve.
4. Manufacturers and Products:
   a. Masoneilan; Series 77-4.
   b. Fisher; Series 67FR.

L. Pressure Regulator, Water:

1. Materials:
   a. Body: Bronze.
   b. Spring Case: Cast iron.
   c. Seat Rings: Brass.
   d. Valve Disk and Holder: Buna-N and bronze.
   e. Diaphragm: Buna-N diaphragm.
2. Sizing: For maximum of 7 psi offset pressure.
3. Manufacturers and Products:
   a. Fisher; Controls Type 95H or 95L.
   b. Masoneilan; Series 17.

M. Test Tap:

1. Manufacturers and Products:
   a. Imperial-Eastman; quick-disconnect couplings No. 292-P and caps No. 259-P.
   b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.
   c. Parker; CPI Series precision quick couplings.

N. Copper Tubing and Fittings:

1. Type K hard copper, ASTM B88, with commercially pure wrought copper solder joint fittings. Make joints with 95-5 wire solder, ASTM B32, Grade 95 TA. Do not use cored solder.
2. Alternatively, Type K, soft temper copper tubing, ASTM B88, with brass compression type fittings may be used where shown on Drawings.
3. Manufacturers:
   a. Parker-Hannifin.
   b. Swagelok tube fittings.

O. Plastic Tubing and Fittings:

1. Tubing:
   a. Polyethylene capable of withstanding 190 psig at 175 degrees F.
   b. Manufacturers and Products:
      1) Dekoron; Type P.
      2) Imperial Eastman; Poly-Flo black instrument tubing.
2. Fittings:
   a. Type: Brass compression.
   b. Manufacturers and Products:
      1) Imperial Eastman; Poly-Flo tube fittings.
      2) Dekoron; E-Z fittings.

P. Stainless Steel Tubing: ASTM A312/A312M, Type 316, 0.065-inch wall, seamless, soft annealed, as shown on Drawings.

Q. Stainless Steel Fittings:

1. Compression Type:
   a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, flareless.
   b. Manufacturers and Products:
      1) Parker Flodar; BA Series.
      2) Swagelok tube fittings.
      3) Parker CPI tube fittings; Parker A-LOK dual ferrule tube fittings.

2. Socket Weld Type:
    a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, 3,000 psi maximum working pressure, safety factor 4:1.
    b. Manufacturers:
        1) Cajon.
        2) Swagelok.
        3) Parker WELDLOK.

R. Air Set: Consists of a shutoff valve, pressure regulator, discharge pressure gauge, and interconnecting tubing.

S. Purge Set:

1. Parts: Purge rotameter flow element, pressure regulator, pressure gauge, test tap, shutoff valve, spool valve, and interconnecting tubing as shown on Drawings and as required in this section.
2. Pressure Gauge Scale Range: 150 percent of the process variable.
3. Mounting:
    a. Within consoles, panels, or a separate enclosure as shown.
    b. For separate enclosure mounted purge sets, refer to paragraphs Nonfreestanding Panel Construction and Factory Finishing for enclosure requirements.

T. Tubing Raceways:

1. Cable tray systems complete with tees, elbows, reducers, and covers.
2. Size in accordance with manufacturer’s recommendations for intended service.
3. Materials: Galvanized steel or aluminum brass as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
4. Manufacturers:
    a. Globetray.
    b. Cope.

U. Air Supply Sets:

1. Parts: Integrally Mounted:
    a. Pressure Controls: Automatic START/STOP, factory set at 30 psig to 50 psig.
    b. Valves: Manual drain, manual shutoff, pressure relief, and check valve.
    c. Pressure gauge.
    d. Inlet filter muffler.
    e. Power: 120V ac.

f. Compressor: Oilless, single cylinder, rated for at least 1 scfm at 50 psig.
g. Manufacturers and Products:
1) ITT Pneumotive; GH Series.
2) Gast.

2. Simplex Air Supply Sets:
a. Air Receiver: 2 gallons.
b. Compressors: One.

3. Duplex Air Supply Sets:
a. Air Receiver: 20 gallons.
b. Compressors: Two.
c. Automatic Failover Control: Factory set at 20 psig.

2.03 ELECTRICAL COMPONENTS

A. Terminal Blocks for Enclosures:

1. General:
a. Connection Type: Screw compression clamp.
b. Compression Clamp:
1) Complies with DIN-VDE 0611.
2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
3) Guides strands of wire into terminal.
c. Screws: Hardened steel, captive, and self-locking.
d. Current Bar: Copper or treated brass.
e. Insulation:
1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
2) Two funneled shaped inputs to facilitate wire entry.
f. Mounting:
1) Standard DIN rail.
2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
3) End Stops: Minimum of one at each end of rail.
g. Wire Preparation: Stripping only permitted.
h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
i. Marking System:
1) Terminal number shown on both sides of terminal block.
2) Allow use of preprinted and field marked tags.
3) Terminal strip numbers shown on end stops.

4) Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.
5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.

j. Test Plugs: Soldered connections for 18 AWG wire.
1) Pin Diameter: 0.079 inch.
2) Quantity: 10.
3) Manufacturer and Product: Entrelec; Type FC2.

2. Terminal Block, General Purpose:
a. Rated Voltage: 600V ac.
b. Rated Current: 30 amp.
c. Wire Size: 24 AWG to 10 AWG.
d. Rated Wire Size: 10 AWG.
e. Color: Gray body.
f. Spacing: 0.25 inch, maximum.
g. Test Sockets: One screw test socket 0.079-inch diameter.
h. Manufacturer and Product: Entrelec; Type M4/6.T.

3. Terminal Block, Ground:
a. Wire Size: 24 AWG to 10 AWG.
b. Rated Wire Size: 10 AWG.
c. Color: Green and yellow body.
d. Spacing: 0.25 inch, maximum.
e. Grounding: Electrically grounded to mounting rail.
f. Manufacturer and Product: Entrelec; Type M4/6.P.

4. Terminal Block, Blade Disconnect Switch:
a. Rated Voltage: 600V ac.
b. Rated Current: 10 amp.
c. Wire Size: 22 AWG to 10 AWG.
d. Rated Wire Size: 10 AWG.
e. Color: Gray body, orange switch.
f. Spacing: 0.25 inch, maximum.
g. Manufacturer and Product: Entrelec; Type M4/6.SNT.

5. Terminal Block Diode:
a. Rated Voltage: 24V dc.
b. Rated Current: 30 ma.
c. Wire Size: 16 AWG.
d. Manufacturer and Product: Phoenix Contact ST-IN.

6. Terminal Block, Fused, 24V dc:
a. Rated Voltage: 600V dc.
b. Rated Current: 25 amp.
c. Wire Size: 22 AWG to 10 AWG.
d. Rated Wire Size: 10 AWG.
e. Color: Gray body.
f. Fuse: 0.25 inch by 1.25 inches.
g. Indication: LED diode 24V dc.

h. Spacing: 0.512 inch, maximum.
i. Manufacturer and Product: Entrelec; Type ML10/13.SFD.

7. Terminal Block, Fused, 120V ac:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 25 amp.
   c. Wire Size: 22 AWG to 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body.
   f. Fuse: 0.25 inch by 1.25 inches.
   g. Indication: Neon lamp, 110V ac.
   h. Leakage Current: 1.8 mA, maximum.
   i. Spacing: 0.512 inch, maximum.
   j. Manufacturer and Product: Entrelec; Type ML10/13.SFL.
8. Terminal Block, Fused, 120V ac, High Current:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 35 amps.
   c. Wire Size: 18 AWG to 8 AWG.
   d. Rated Wire Size: 8 AWG.
   e. Color: Gray.
   f. Fuse: 13/32 inch by 1.5 inches.
   g. Spacing: 0.95 inch, maximum.
9. Manufacturer and Product: Entrelec; Type MB10/24.SF.

B. Relays:

1. General:
   a. Relay Mounting: Plug-in type socket.
   b. Relay Enclosure: Furnish dust cover.
   c. Socket Type: Screw terminal interface with wiring.
   d. Socket Mounting: Rail.
   e. Provide holddown clips.
2. Signal Switching Relay:
   a. Type: Dry circuit.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 5 amps at 28V dc or 120V ac.
   d. Contact Material: Gold or silver.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 0.9 watt (dc), 1.2VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Seal Type: Hermetically sealed case.
   k. Manufacturer and Product: Potter and Brumfield; Series KH/KHA.

3. Control Circuit Switching Relay, Nonlatching:
    a. Type: Compact general purpose plug-in.
    b. Contact Arrangement: 3 Form C contacts.
    c. Contact Rating: 10A at 28V dc or 120V ac, and 6.6A at 240V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Coil Voltage: As noted or shown.
    f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
    g. Expected Mechanical Life: 10,000,000 operations.
    h. Expected Electrical Life at Rated Load: 100,000 operations.
    i. Indication Type: Neon or LED indicator lamp.
    j. Push-to-test button.
    k. Manufacturer and Product: Potter and Brumfield; Series KUP.
4. Control Circuit Switching Relay, Latching:
    a. Type: Dual coil mechanical latching relay.
    b. Contact Arrangement: 2 Form C contacts.
    c. Contact Rating: 10A at 28V dc or 120V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Coil Voltage: As noted or shown.
    f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
    g. Expected Mechanical Life: 500,000 operations.
    h. Expected Electrical Life at Rated Load: 50,000 operations.
    i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.
5. Control Circuit Switching Relay, Time Delay:
    a. Type: Adjustable time delay relay.
    b. Contact Arrangement: 2 Form C contacts.
    c. Contact Rating: 10A at 30V dc or 277V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Coil Voltage: As noted or shown.
    f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
    g. Repeatability: Plus or minus 2 percent.
    h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent of range.
    i. Time Delay Setpoint: As noted or shown.
    j. Mode of Operation: As noted or shown.
    k. Adjustment Type: Integral potentiometer with knob external to dust cover.
    l. Manufacturer and Products: Potter and Brumfield; Series CB for 0.1-second to 100-minute delay time ranges, Series CK for 0.1-second to 120-second delay time ranges.

C. Surge Suppressors:

1. General:
   a. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
   b. Response: 5 nanoseconds maximum.
   c. Recovery: Automatic.
   d. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
   e. Enclosure Mounted: Encapsulated inflame retardant epoxy.
2. Suppressors on 120V ac Power Supply Connections:
   a. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
   b. First-Stage Clamping Voltage: 350 volts or less.
   c. Second-Stage Clamping Voltage: 210 volts or less.
   d. Power Supplies for Continuous Operation:
      1) Four-Wire Transmitter or Receiver: Minimum 5 amps at 130V ac.
      2) All Other Applications: Minimum 30 amps at 130V ac.
3. Suppressors on Analog Signal Lines:
   a. Test Waveform: Linear 8-microsecond rise in current from 0 amps to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
   b. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
      1) dc Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
      2) dc Clamping Voltage Tolerance: Plus or minus 10 percent.
      3) Maximum Loop Resistance: 18 ohms per conductor.
4. Manufacturers and Products:
   a. Analog Signals Lines: Emerson Edco PC-642 or DRS-036 series.
   b. 120V ac Lines: Emerson Edco HSP-121.
   c. Field Mounted at Two-Wire Instruments:
      1) Encapsulated in stainless steel pipe nipples.
      2) Emerson Edco SS64 series.
   d. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
      1) Enclosure:
         a) NEMA 4X Type 316 stainless steel with door.
         b) Maximum Size: 12 inches by 12 inches by 8 inches deep.
      2) Emerson Edco; SLAC series.

D. Power Supplies:

1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
3. Provide output over voltage and over current protective devices to:
   a. Protect instruments from damage due to power supply failure.
   b. Protect power supply from damage due to external failure.
4. Enclosures: NEMA 1.
5. Mount such that dissipated heat does not adversely affect other components.
6. Fuses: For each dc supply line to each individual two-wire transmitter.
   a. Type: Indicating.
   b. Mount so fuses can be easily seen and replaced.

E. Intrinsic Safety Barriers:

1. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
   a. Manufacturer and Product: MTL, Inc.; Series MTL 5000.
2. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.
   a. Manufacturer and Product: MTL, Inc.; Series MTL 5000.

2.04 I&C COMPONENTS

A. F134 Flow Element and Transmitter, Ultrasonic, Doppler:

1. General:
   a. Function: Measure flowrate of aerated liquids or liquids containing solids.
   b. Type: Doppler operating principle, clamp-on transducers.
   c. Parts: Single head transducer, transmitter, interconnecting cable.
2. Service:
   a. Process Fluid: As noted.
   b. Pipe Material: As noted.
   c. Pipe Size: As noted.
3. Performance:
   a. Process Flow Range: As noted.
   b. Accuracy: Plus or minus 2 percent of reading or 0.1 ft/sec velocity.

c. Operating Temperature:
   1) Transducer, Pipe Surface: Minus 40 degrees F to 300 degrees F, unless otherwise noted.
   2) Transducer, Ambient Air: 176 degrees F.
   3) Transmitter: Minus 10 degrees F to 140 degrees F.
d. Transducer Certification: Class I, Div 2, Groups A, B, C, and D, unless otherwise noted.

4. Transducer:
   a. Single head.
   b. Weatherproof.
   c. Suitable submersion pressures up to 10 psi.
5. Transmitter:
   a. Enclosure: NEMA 4X polyester and polycarbonate IP66 with gasketed shatter-proof window, unless otherwise noted.
   b. Keypad: 5-key.
   c. Screen: Backlit matrix LCD display.
   d. Data Logger:
      1) 26 million data point capacity, minimum.
      2) Retrieval software compatible with Windows.
6. Interconnecting Cable: Length as required to wall-mount transmitter.
7. Signal Interface:
   a. 4 to 20 mA dc output for load impedance of 0 ohms to 1000 ohms for 24V dc power supply without load adjustments (loop or self powered).
   b. Alarm Relays: Two SPDT rated for 5 amps continuous, unless otherwise noted.
   c. RS 232 serial interface.
8. Power: 120V ac, 50/60-Hz, unless otherwise noted.
9. Manufacturer and Product: Greyline Instruments, Inc; Model DFM 6.1 Doppler Flowmeter.

B. M26 Hand Switch and Light, Corrosion, Round:

1. General:
   a. Function: Select, initiate, and display discrete control functions.
   b. Type: Heavy-duty, corrosion-resistant, industrial.
2. General Features:
   a. Mounting: 30.5 mm single round hole. Panel thickness 1/16 inch to 1/4 inch.
   b. Legend Plate: Standard size, square style laminate with white field and black markings, unless otherwise noted. Markings as shown, or as implied by P&IDs.
   c. Configuration: Light, pushbutton, or switch as noted or shown.

3. Light Features:
    a. Lights: 6V ac lamps and integral transformer for operation for operation from 120V ac, unless otherwise noted.
    b. Lens Color: Color as specified, noted, or shown.
    c. Push-to-test, unless otherwise noted.
    d. Additional: As noted.
4. Pushbutton Features:
    a. Operator: Single pushbutton, flush, unless otherwise noted.
    b. Color: Black, unless otherwise noted.
    c. Boot: None, unless otherwise noted.
    d. Contact Arrangement: As required or shown.
    e. Additional: As noted.
5. Selector Switch Features:
    a. Operator: Knob, unless otherwise noted.
    b. Color: Black, unless otherwise noted.
    c. Boot: None, unless otherwise noted.
    d. Positions: As required or shown.
    e. Return: Manual, unless otherwise noted.
    f. Contact Arrangement: As required or shown.
    g. Additional: As noted.
6. Signal Interface:
    a. Contact Block:
        1) Type: Standard, unless otherwise noted.
        2) Materials: Silver amalgam, unless otherwise noted.
        3) Rating: 10 amps continuous at 120V ac, unless otherwise noted.
        4) Sequence: Break-before-make, unless otherwise noted or shown.
        5) Arrangement: Normally open or normally closed as shown, or to perform the functions noted.
7. NEMA Rating: NEMA 4, watertight, dust-tight, and NEMA 4X, corrosion-resistant.
8. Manufacturers and Products:
    a. Square D Co.; Class 9001, Type SK.
    b. Allen-Bradley; Bulletin 800H.
    c. Eaton Corp.; Cutler-Hammer, Type E34.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 40 99 90
PACKAGE CONTROL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
2. International Society of Automation (ISA): S50.1, Compatibility of Analog Signals for Electronic Process Instruments.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
   c. ICS 2, Industrial Control Devices, Controllers and Assemblies.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories Inc. (UL): 508A, Standards for Safety, Industrial Control Panels.

1.02 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer’s factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer’s factory.

1.03 SUBMITTALS

A. Action Submittals:

1. Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
2. Catalog information on electrical devices furnished with system.
3. Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.

4. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
5. Plumbing diagrams of pre-plumbed panels and interconnecting plumbing diagrams.
6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.
7. Panel Power Requirements and Heat Dissipation: As defined in Section 40 90 00, Instrumentation and Control for Process Systems.
8. Intrinsic Safety Data: Provide calculations, tables and other data that document entity method application to each circuit using intrinsic safety as a means of dealing with classified area requirements. Include intrinsic safety parameters for devices (maximum voltage allowed, maximum current allowed, internal capacitance, internal inductance, etcetera) and barriers (open circuit voltage, short circuit current, allowed capacitance, and allowed inductance) for all devices in all circuits.
9. Programmable Controller Submittals:
    a. Hardware Documentation:
        1) Provide the following for all elements of the PLC:
            a) Block Diagram: A diagram showing all major system components. Identify components by manufacturer and model number. Show interconnecting cables diagrammatically.
            b) Bill-of-Materials: A list of all PLC components. Group components by type and include:
            c) Component manufacturer, model number, and part number.
            d) Component description.
            e) Quantity supplied.
    b. Software Design Submittal: Provides a detailed description on the application program during applications program development and well before submission of the Preliminary Software Documentation. Include all PLC and OIU program backups.

B. Informational Submittals: Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

PART 2 PRODUCTS

2.01 SIGNAL CHARACTERISTICS

A. As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

2.02 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsule Manufacturers:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A-HCI.

2.03 PROGRAMMABLE CONTROLLERS, AND ETHERNET NETWORK SWITCHES

A. PLC Requirements (if provided):

1. Allen Bradley MicroLogix 1400 with Ethernet and Required I/O, or Approved Equal.
2. Operator terminal shall be Allen Bradley PanelView 800, 4” color touchscreen, or Approved Equal.
3. PLC and interface terminal programs shall be provided to the owner at the conclusion of the project. Programs shall be fully documented and not password protected.

B. Ethernet Network Switches: Not required.

2.04 CONTROL PANEL

A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 698, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

B. Conform to NEMA ratings as specified in individual equipment sections.

C. Minimum Metal Thickness: 14 gauge.

D. NEMA 250, Type 4X Panels: Type 304 stainless steel construction unless otherwise specified.

E. Doors: Three-point latching mechanisms.

F. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.

G. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.

H. Temperature Control: As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

I. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.

J. Lighting: Minimum of one Switched LED lighting package for panels 12 cubic feet and larger.

K. Minimum of one 120-volt GFCI duplex receptacle for panels 12 cubic feet and larger.

L. Finish:

1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer’s standard gray unless otherwise specified.
2. Internal Surfaces: White enamel.

M. Standard Pushbutton Colors and Inscriptions:

1. Use following unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black

Tag Function	Inscription(s)	Color
OOA	ON OFF AUTO	Black Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

a. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

2. Standard Light Colors and Inscriptions:
   a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color
ON	ON	Green
OFF	OFF	Red
OPEN	OPEN	Green
CLOSED	CLOSED	Red
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

   b. Lettering Color:
      1) Black on white and yellow buttons.
      2) White on black, red, and green buttons.

N. Panel Manufacturers:

1. Hoffman.
2. H.F. Cox.

O. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels.

1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

2.05 CONTROL PANEL ELECTRICAL

A. UL Listing Mark for Enclosures: Mark stating “Listed Enclosed Industrial Control Panel” per UL 698A.

B. Safety-Related Nameplates: As required by applicable codes and standards including NFPA 79 and UL 698A. Provide a warning nameplate on all control panel enclosures with circuits with more than one electrical supply. For example, any panel with dry contacts in a circuit powered elsewhere.

C. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

D. Control Panels without Motor Starters:

1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
3. Circuit Breakers:
    a. Coordinate for fault in branch circuit trips, branch breaker, and not main breaker.
    b. Branch Circuit Breakers: 15 amps at 250V ac.
    c. Breaker Manufacturers and Products:
        1) Heineman Electric Co.; Series AM.
        2) Airpax/North American Philips Controls Corp.; Series 205.

E. Control Panels with Three-Phase Power Supplies and Motor Starters:

1. Interlock main circuit breaker with panel door.
    a. Mount logic controls, branch circuit breakers, overload reset switches, and other control circuit devices.
    b. Mount operator controls and indications on front access door.

2. Circuit Breakers:
    a. In accordance with NEMA AB 1.
    b. Breakers, except Motor Branch Breakers: Molded case thermal magnetic.
    c. 42,000 ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified in package system equipment specification sections.
    d. Tripping: Indicate with operator handle position.
3. Magnetic Motor Starters:
    a. Full voltage, NEMA ICS 2, Class A, Size O minimum.
    b. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
    c. Manual reset type with reset button mounted on panel door.
4. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
    a. Power Control Transformer:
        1) Sufficient capacity to serve connected load, including 200VA for duplex outlet plus 100VA (minimum).
        2) Limit voltage variation to 15 percent during contact pickup.
        3) Fuse one side of secondary winding and ground the other.
        4) Furnish primary winding fuses in ungrounded conductors.
5. Power Monitoring Relay:
    a. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
    b. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
    c. Transient Voltage Protection: 10,000 volts.
    d. Manufacturer and Product: Furnas; Class 47.
6. Power Distribution Blocks: Furnish to parallel feed tap on branch circuit protective devices. Do not “leap frog” power conductors.
7. Terminations for Power Conductors: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

F. Wiring: As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

G. Wiring Interface: As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

H. Terminal Blocks: As defined in Section 40 91 00, Instrumentation and Control Components.

I. Grounding: As defined in Section 40 91 00, Instrumentation and Control Components.

J. Relays: As defined in Section 40 91 00, Instrumentation and Control Components.

K. Intrinsic Safety Barriers: As defined in Section 40 91 00, Instrumentation and Control Components.

L. Analog Signal Isolators: As defined in Section 40 91 00, Instrumentation and Control Components.

M. Power Supplies: As defined in Section 40 91 00, Instrumentation and Control Components.

N. Front-of-Panel Devices in Conjunction with NEMA 250, Type 1 and 12 Panels:

1. Potentiometer Units:
    a. Three-terminal, oiltight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
    b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.
    c. Include legend plates with service markings.
    d. Manufacturers and Products:
        1) Allen-Bradley; Model 800T.
        2) Eaton/Cutler-Hammer; Model 10250T.
2. Indicating Lights:
    a. Heavy-duty, push-to-test type, oiltight, industrial type with integral transformer for 120V ac applications.
    b. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.
    c. Manufacturers and Products:
        1) Eaton/Cutler-Hammer; Type 10250T.
        2) General Electric; CR2940U.
3. Pushbutton, Momentary:
    a. Heavy-duty, oiltight, industrial type with full guard and momentary contacts rated for 10 amperes continuous at 120V ac.
    b. Standard size legend plates with black field and white markings for service legend.
    c. Manufacturers and Products:
        1) Square D; Class 9001, Type K.
        2) Eaton/Cutler-Hammer; Type T.
        3) General Electric; Type CR-2940.

4. Selector Switch:
    a. Heavy-duty, oiltight, industrial type with contacts rated for 120V ac service at 10 amperes continuous.
    b. Standard size, black field, legend plates with white markings, for service legend.
    c. Operators: Black knob type.
    d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
    e. Manufacturers and Products for Units with up to Four Selection Positions:
        1) Eaton/Cutler-Hammer; Type T.
        2) Square D; Type K.
    f. Manufacturers and Products for Units with up to 12 Selection Positions:
        1) Rundel-Idec; Standard Cam Switch.
        2) Electroswitch; 31.

O. Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels:

1. Potentiometer, Watertight:
    a. Three-terminal, heavy-duty NEMA 250, Type 4X watertight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
    b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.
    c. Include engraved legend plates with service markings.
    d. Manufacturer and Product: Allen-Bradley; Bulletin 800H.
2. Indicating Lights, Watertight:
    a. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.
    b. Screwed on prismatic lenses and factory engraved legend plates for service legend.
    c. Manufacturers and Products:
        1) Square D; Type SK.
        2) Allen-Bradley; Type 800H.
3. Pushbutton, Momentary, Watertight:
    a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
    b. Standard size, black field, legend plates with white markings for service legend.
    c. Manufacturers and Products:
        1) Square D; Type SK.

2) Allen-Bradley; Type 800H.

4. Selector Switch, Watertight:
   a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
   b. Standard size, black field, legend plates with white markings, for service legend.
   c. Operators: Black knob type.
   d. Single-hole mounting, accommodating panel thicknesses from 1/16 to 1/4 inch.
   e. Manufacturer and Products:
      1) Square D; Class 9001, Type SK.
      2) Allen-Bradley; Type 800H.

2.06 INSTRUMENT TAG NUMBERS

A. A shorthand tag number notation is used. For example:

AI-1-12(2)(3)[pH]

Notation	Explanation
AI	ISA designator for Analysis Indicator
1	Unit process number
12	Loop number
(2)	First unit number; number of same component types in a given loop; -1 and 1-2 in this example
(3)	Second unit number; number of same component types with same first unit number in a given loop; -1, -2, and -3 in this example
[pH]	Same notation shown at 2 o'clock position on ISA circle symbol on Process and Instrument Diagram

B. In this example, AI-1-12(2)(3)[pH] is shorthand for:

AI-1-12-1-1[pH], AI-1-12-1-2[pH], AI-1-12-1-3[pH]

AI-1-12-2-1[pH], AI-1-12-2-2[pH], AI-1-12-2-3[pH]

2.07 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

A. As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

2.08 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

PART 3 EXECUTION

3.01 ENCLOSURE INTERNAL WIRING

A. As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

3.02 PROTECTION

A. As defined in Section 40 90 00, Instrumentation and Control for Process Systems.

3.03 SUPPLEMENTS

A. Supplements listed below, follows “End of Section,” are part of this Specification.

1. Loop Descriptions.
2. PLC Input/Output List.
3. Control Panel Schedule.

END OF SECTION

LOOP DESCRIPTIONS

Note(s):

1. This document does not describe every function required by the Contract Documents. Rather, it supplements and clarifies the functions required by the P&IDs and panel wiring diagrams.

2. Also refer to Supplement 2 I/O List.

ALARMS

Display all alarms shown on the P&IDs and I/O List, including any existing alarms.

STATUS MONITORING

Display all status signals shown on the P&IDs and I/O List. Examples include hand switch in Auto; pump X ON status; pump fail, etc.

UNIT PROCESSES

A. 08-N-602 – Headworks Drum Screen, FP-12-3 (Vendor Packaged Panel)

1. General: The Drum Screen is designed to remove solids from the Influent Wastewater at the beginning of the Headworks and dispose of them in a screenings dumpster. A door interlock shall be provided to prevent operation of the entire Drum Screen when the door is open.
2. HAND Operation: When HS-12-17A is in the HAND position the motor can be started and will run in the direction selected by the FORWARD/REVERSE switch. Run Status will be displayed on the HMI. REVERSE mode should only be ON for a short moment to prevent increased brush wear. When HS-12-21 is in the HAND position the Washwater Solenoid Valve will open. HS-12-22 is in the HAND position the Press Zone Flush Solenoid Valve will open.
3. OFF Operation: When HS-12-17A is in the off position the motor shall be stopped. Once the motor has completely stopped, the motor direction of travel can be changed using the FORWARD/REVERSE switch HS-12-17B. Off Status will be displayed on the HMI. When HS-12-21 is in the OFF position the Washwater Solenoid Valve will close. HS-12-22 is in the OFF position the Press Zone Flush Solenoid Valve will close.
4. ESTOP Operation: Power is immediately removed from the motor and W3 water solenoids and remains off until the ESTOP button is pulled out again.

5. AUTO Operation: When HS-12-17A, HS-12-21, and HS-12-22 are in the AUTO position the motor will start when the level reading from LIT-12-22 reaches the ON Level Setpoint on the OIU, the motor will turn ON automatically in the FORWARD direction to move the captured screenings up and into the screw conveyor while the W3 washwater solenoid OPENS to spray the screenings before it exits the top of the conveyor to a dumpster chute. The motor continues running until an operator adjustable time delay on the OIU has been reached and the level reaches an Operator-adjustable OFF Setpoint on the OIU. The motor turns OFF and the W3 washwater solenoid CLOSES automatically. In AUTO mode, the drum will run in reverse every 15 minutes for several seconds. AUTO mode status signal shall be hardwired to CP-16-3.
6. REVERSE Operation: The motor turns on in the REVERSE direction for maintenance and cleaning. This mode should only be ON for a short moment to prevent increased brush wear. In AUTO mode, the drum will run in reverse every 15 minutes for several seconds and OPEN the Press Zone Flush solenoid valve.
7. When the motor Overload switch is active, the motor will be powered off until the integral RESET pushbutton is pressed.
8. The level LI-12-22 in the Drum Screen shall be displayed on the panel door and OIU. When the level reaches an operator-adjustable HIGH Level Setpoint, LSH-12-22 shall be active.
9. When LSH-12-22 or E-STOP or motor Overload are active, the status shall be hardwired to CP-16-3 as a single General Fail Alarm.
10. In any mode of operation, the motor Run Status shall be sent to CP-16-3 as a hardwired signal.

END OF LOOP DESCRIPTIONS

I/O LIST

PLC	Drawing	Tag	Function/Description	DI	DO	AI	AO	Comment
FP-12-3	08-N-602	M-12-17-YS	DRUM SCREEN RUN STATUS	1				Hard wired signals allowed in lieu of PLC outputs
FP-12-3	08-N-602	M-12-17-YS2	DRUM SCREEN RUN STATUS		1			Hard wired signals allowed in lieu of PLC outputs
FP-12-3	08-N-602	M-12-17-FA	DRUM SCREEN ESTOP ALARM	1				Hard wired signals allowed in lieu of PLC outputs
FP-12-3	08-N-602	M-12-17-HOA:AUTO	DRUM SCREEN HOA SWITCH IN AUTO	1				Hard wired signals allowed in lieu of PLC outputs
FP-12-3	08-N-602	LI-12-22	DRUM SCREEN LEVEL			1		
FP-12-3	08-N-602	M-12-17-YS2	DRUM SCREEN ESTOP ALARM		1			
FP-12-3	08-N-602	LSH-12-22	DRUM SCREEN HIGH LEVEL ALARM		1			
FP-12-3	08-N-602	M-12-17-INT	DRUM SCREEN ACCESS DOOR INTERLOCK	1				
FP-12-3	08-N-602	M-12-17-XA	DRUM SCREEN GENERAL FAIL ALARM		1			
FP-12-3	08-N-602	FV-12-21-HOA:AUTO	WASHWATER VALVE HOA SWITCH IN AUTO	1				
FP-12-3	08-N-602	FV-12-22-HOA:AUTO	PRESS ZONE FLUSH VALVE HOA SWITCH IN AUTO	1				
FP-12-3	08-N-602	FV-12-21:OC	WASHWATER VALVE OPEN COMMAND		1			
FP-12-3	08-N-602	FV-12-22:OC	PRESS ZONE FLUSH VALVE OPEN COMMAND		1			
								Include any additional signals required for a fully functional system
			FP-12-3 (Vendor Packaged Panel)	6	6	1	0	

MILLEY'S CREEK WATER POLLUTION CONTROL PLANT

CONTROL PANEL LIST

This list includes only those panels which are part of the Package Control Systems.

Tag No.	Description	Enclosure Type**	Location	Installation Details/Drawings	Remarks
FP-12-3	Headworks Micro Strainer Control Panel	NEMA 4X, 304 Stainless Steel, Wall Mount, 3-point latch, 36" x 36" x 16"	Headworks Platform	4091-388PD	Provide PLC, 4" Touchscreen (OIU), 120V ac Surge Protection, Full Voltage Reversing Starter, Through-Door Disconnect Handle, E-Stop, Intrinsic Safety Barrier
**Enclosure sizes shown are minimum required. Provide larger sizes if required to accommodate all devices.					

SECTION 44 42 30
TANK MOUNTED SPIRAL SCREEN

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA): 9 & 11, Load Ratings and Fatigue Life for Roller Bearings.
2. American Gear Manufacturers Association (AGMA):
   a. 2015-1-A01, Accuracy Classification System – Tangential Measurements for Cylindrical Gears.
   b. 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
   c. 9005-E02, Industrial Gear Lubrication.
3. American Welding Society (AWS):
   a. B2.1, Standard Welding Procedure and Performance Qualification.
   b. D1.1/D1.1M, Structural Welding Code – Steel.
   c. QC 1, Standard for AWS Certification of Welding Inspectors.
4. ASTM International (ASTM):
   a. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   b. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
   c. D3917, Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastics Pultruded Shapes.
5. National Electrical Code (NEC).
6. National Electrical Manufacturers' Association (NEMA): MG 1, Motors and Generators.
7. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.02 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide a tank mounted spiral fine screening system as described herein capable of handling a peak flow rate of 2.0 mgd municipal raw sewage plus 0.5 mgd additional recycle flow. Overall head loss through the screening equipment shall be less than 15 inches at peak flow rate.

B. Design Requirements:

1. Complete the design of the screening system as specified herein and as shown on the Drawings.
2. Elevations shown on the Drawings shall be field verified by Contractor prior to commencing work.
3. Provide and place into service a screen consisting of the following equipment:
   a. One tank mounted spiral fine screening unit with 1/4 inch perforated screen basket and associated tank, screenings conveyor, wash-press, and discharge chute.
4. Influent Sampler Requirements:
   a. Design of tank assembly shall provide a sampling port for the 3/8 inch minimum influent sampler suction tube to be placed into the flow stream inside the screen tank upstream of 1/4 inch screen basket. Sampling port shall be a threaded pipe and a cap shall be provided to allow the port to be sealed off when needed.
   b. Sampling port shall be located on tank assembly where:
      1) A minimum of 3 feet of intake tubing will be used
      2) The strainer will be submerged at all times
      3) There will be no interference of the intake tubing and strainer with the spiral screen assembly, under any circumstance.
   c. Contractor shall relocate the influent refrigerated sampler from the existing headworks system to the new screening system.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Sufficient detail to verify conformance with each and every requirement of this Specification.
   b. Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials for construction.
   c. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Provide structural submittals as required in Division 5 Metals.
   d. Dimensions, size, and locations of connections to other work.
   e. Details of attachment and support of each piece of equipment.

f. Hydraulic performance curves for screening unit. Show the relationship of headloss versus the full range of downstream liquid depths for the following conditions:
   1) Max. Hydraulic Capacity: 2.5 mgd.
   2) Design max. month flow plus plant drain recycle: 2.0 mgd.
   3) 60 percent of design max. month flow plus plant drain recycle: 1.4 mgd.
   4) 60 percent of design max. month flow plus plant drain recycle: 0.95 mgd.

g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and motor modifications. See Division 26, Electrical, for motor submittal requirements.

h. Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed.

i. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.

j. Power and control wiring diagrams, including terminals and numbers.

k. Detailed dimensional Drawings for all control panels and terminal junction boxes. The specific materials to be used in the panels shall be included in the submittal information as well as the enclosure ratings.

l. Shop painting systems, including manufacturer’s descriptive technical catalog literature and specifications.

m. External utility requirements for air, water, power, drain for each component.

B. Informational Submittals:

1. Statements of Qualification: Professional structural engineer.
2. Manufacturer’s Certificate of Compliance of factory-applied coating system.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer’s installation instructions.
5. Manufacturer’s Certificate of Proper Installation.
6. Field functional test reports.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data, including routine maintenance requirements prior to plant startup.
8. Welding Inspector’s Report.

1.04 QUALIFICATIONS

A. Welder/Welding Operator: In accordance with AWS D1.1/D1.1M.

B. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with welding codes specified.

1.05 EXTRA MATERIALS

A. Furnish, tag, and box the following spare parts and special tools:

Item	**Quantity**
Brushes	Two complete units
Drive shaft end bearings, if applicable	One complete unit
Solenoid valve	One of each type and size installed
Solenoid valve repair kit	One
Lower bearing assembly	One
Set of fuses for control panel	One complete set
Light bulbs for control panel	One complete set
Special tools required to maintain or dismantle unit	One complete set

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Equipment and accessories specified in this section shall be products of:

1. Parkson; Model HLS500M35P Helisieve Plus.
2. Huber Technology, Inc.; Rotamat® Microstrainer Ro9/500/6.
3. Or approved equal.

B. The Contractor shall be responsible to complete the design based on requirements listed herein and shown on the Drawings. If the Contractor proposes to use a different equipment supplier than the first or second named equipment supplier, then the Contractor shall be responsible for all modifications required to the implement the alternative equipment supplier.

C. In order to ensure uniform quality, ease of maintenance and minimal parts storage, all equipment called for under this section shall be furnished by a single responsible equipment supplier. The equipment supplier shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.

2.02 SERVICE CONDITIONS

A. Material Handled: Municipal Raw Sewage.

B. Location: Outdoors (20 degrees F minimum to 100 degrees F maximum).

C. Exposure: Variable concentrations of hydrogen sulfide.

D. Equipment Environment Application Rating: NEC:

1. Areas with 10 feet of equipment and channels: Class I, Division 2, Group D.
2. Areas outside 10 feet of equipment and channels: Unclassified.

2.03 GENERAL

A. See Section 01 61 00, Common Product Requirements, for specific requirements related to the equipment specified herein.

B. Welding: Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 and AWWA C206 and the following:

1. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds, and shall prevent entrance of air or moisture.
2. Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society’s “Welding Handbook” as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standards.
3. In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

C. Safety Devices: The completed work shall include all necessary permanent safety devices, such as machinery guards, emergency stops and similar items required by OSHA, and other federal, state, and local health and safety regulations.

D. Flanges and Pipe Threads: Flanges on equipment shall comply with ANSI B16.1, Class 125; or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1.

E. Bearings:

1. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
2. Except where otherwise indicated, bearings of process equipment shall have a minimum L 10 life expectancy of 100,000 hours.

F. Packings: Packing around rotating shafts (other than valve stems) shall be mechanical seals, as specified by the manufacturer. Interconnection water supply and drain piping shall be as shown on the Drawings.

2.04 PERFORMANCE REQUIREMENTS

A. The tank mounted spiral screen unit shall continuously accept municipal raw sewage where screening material larger than the perforation opening size will be captured on the screen basket. The spiral screw will then convey the screening out of the screen tank at either a 35 or 45 degree angle to the compaction zone for dewatering. The screenings will then be discharged through a chute into a screenings dumpster.

B. The screenings backset openings in the unit shall be 1/4 inch.

C. The unit shall be designed to handle no less than the maximum hydraulic capacity flow rate of 2.5 mgd.

D. The unit shall be designed to handle no less than a maximum clean water hydraulic capacity flow rate of 2.5 mgd at a maximum 21 inches of upstream liquid level.

E. The dewatered screenings produced shall be capable of passing the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-486.

2.05 EQUIPMENT DESCRIPTIONS

A. Tank Mounted Spiral Screen Unit:

1. General:
   a. The tank mounted spiral screen system will consist of a tank with a flanged connection inlet, a flanged outlet, a screen basket assembly, a spiral assembly, a transport tube assembly, a press zone, and a discharge assembly, and all other appurtenances shown in Contract Documents.
   b. The system will be designed to receive raw sewage through an influent pipe on the tank assembly. The influent will be directed to the screen where large solids will be retained. The solids will be transported up the spiral at either a 35 or 45 degree angle through the transport tube into the press zone where they will be dewatered. The dewatered solids will then discharged through a chute to a container.
2. Materials of Construction: Spiral constructed of high-strength low-alloy steel per ASTM A606 or stainless steel Type 304. All other equipment elements made of Type 304 stainless steel. All stainless steel equipment components shall undergo a passivation process to ensure maximum resistance to corrosion.
3. Tank Assembly: Consists of a tank and covers.
   a. Tank: The tank shall be constructed with 12 gauge Type 304 stainless steel on the side and able to withstand the hydrostatic load and the screening unit weight. The tank shall be designed to allow for the screenings unit to be pivoted out of the tank for maintenance. Suitable provisions for lifting the tank will be supplied. Provide 12 inch influent and either 12 inch or 14 inch effluent connections equipped with Class 150 ANSI/ASME B16.5 rated flanges. Tank supplied with a curved inlet baffle to reduce splashing and spray.
      1) Design of tank assembly shall provide features for the suction tube of the existing influent sampler to be placed into the flow stream inside the screen tank upstream of ¼ inch screen basket.
      2) Contractor shall relocate the influent refrigerated sampler from the existing headworks system to the new screening system.
   b. Covers: Fabricated from 12 gauge Type 304L stainless steel with gaskets and; one cover to mount ultrasonic/pressure transducer level sensor; one hinged cover for visual inspection. Hinged cover will be fitted with a safety interlock switch to prevent operation of unit when the cover is open.

4. Screen Basket Assembly: Consists of the screen and side seals:
   a. Screen Basket: The perforated screen basket shall have a semi-cylindrical shape, which shall be open at the front and top. It shall be installed parallel to the wastewater flow direction. The screen basket shall be provided with a bottom plate lying flat on the tank floor. The screen shall be provided with an upper support flange and a conical transition piece between the screen basket and auger tube. The screen basket shall be constructed of 11 gauge perforated Type 304 stainless steel. The screen openings will be 1/4 inch diameter.
   b. Side Seals: Screen basket fitted with side seals to direct flow into the screen basket and form a seal between the tank walls and the screen basket.
5. Spiral Assembly: Consists of spiral, brush assembly, and drive shaft.
   a. Spiral: Screen shall have either a shaftless or shafted spiral screw:
      1) Shaftless Spiral Screw: The spiral shall be shaftless except in the press zone and discharge section and will be constructed of high-strength carbon steel. The spiral will be constructed of two concentric flights formed continuously from bar stock and welded together to form a spiral. The outer spiral will have a minimum thickness of 0.59 inches and the inner spiral will have a minimum thickness of 0.39 inch. The spiral will have a constant inner diameter through the entire length. The spiral outer diameter shall be 7.68 inches in the transport section and shall transition to 17.13 inches in the basket with additional flight welded to the outer spiral.

         OR

      2) Shafted Spiral Screw: The screen shall be cleaned with a shafted stainless steel screw with helicoid-shaped flights. The flights of the screw in the basket shall be provided with a 1/4 inch thick hardened stainless steel strip having the same thickness as the flights of the screw. The strip shall be welded to the face of the flight, on both sides, over the full length of the screen basket. The flights of the screw shall be machined to match the screen basket such that the face of the strip is parallel to the screen basket’s inner surface. The shaft shall have a minimum diameter of 3-1/2 inch (89 mm) and shall have flights with a thickness of 1/4 inch in the auger tube and a minimum thickness of 0.4 inch (10 mm) in the press zone.

b. Brush Assembly: The spiral in the screen basket shall be fitted with a water-resistant brush, which will clean the screen basket openings and be fastened to the trailing side of the spiral edge in the screen basket. Brush sections shall be mounted to form a continuous brush and clean the entire basket area during operation. The brush sections shall have stainless steel nuts pressed into the core and be attached to the spiral with stainless steel fasteners.

c. Drive Shaft: The spiral shaft shall be constructed of either carbon steel or stainless steel and welded to the spiral. The shaft shall include a flange with a bolted connection to the drive shaft stub flange for ease of disassembly for maintenance.

6. Transport Tube: The transport tube shall be constructed of 11 gauge Type 304 stainless steel and includes a tapered transition section to convey screenings from the screenings basket, through the straight transport section, and then to the press zone. The transport tube shall be fitted with a minimum of four (4) wear bars in the transition section and four (4) wear bars in the straight section to prevent the spiral from wearing on the surface of the tube. The wear bars shall be constructed of 0.38 inch minimum thickness stainless steel. The wear bars will be fixed to the taper and straight sections of the tube by cap screws inserted through the tube and threaded into tapped holes in the wear bars. This construction will allow for ease of replacement and monitoring of wear rate on the bars by periodic removal and length measurement of the cap screws. Due to the stiffer design of a fully shafted spiral, wear bars are not required for fully shafted designs.

   A minimum of two (2) anti-rotation bars welded to the inside of the transport tube along its longitudinal axis can be used in lieu of the wear bars. The screenings screw conveyor shall not be in contact with the anti-rotation bars during normal operation.

7. Press Zone Assembly: Press zone assembly shall consist of a press zone enclosure, a retractable spool compaction tube, a spray flush system, and a discharge chute. A fully hinged top cover allows for easy access.

   a. Press Zone Enclosure: The press zone enclosure will be mounted to the end flange of the transport tube and be constructed of minimum 12 Type 304 stainless steel. The enclosure will include provision to mount the gear reducer, compaction tube and discharge chute. The enclosure shall have a top mounted hinged lid for full access to the press zone and discharge sections. The lid shall be secured with latches for easy access and have an interlock switch to stop the screen when the lid is open. The housing shall be provided with a drain connection at its lowest point and a discharge hose for drain water whose other end directed directly back into the tank unit.

b. Compaction Tube. The compaction tube shall be flange mounted to the inside of the press zone enclosure. The bottom half of the tube shall have a minimum of 1/8 inch perforations to drain the screenings pressate.
c. Spray Flush System. A centralized washing system shall be provided to connect all spray wash system to a common service connection point. The piping manifold shall be constructed from Type 304 stainless steel. The spray system shall have a maximum output of approximately 14 gpm at 60 psi and can use non-potable water.
d. Discharge Chute: The discharge chute shall be bolted to the bottom of the press zone enclosure. It shall include a drain under the compaction tube and have a discharge opening under the discharge section. The pressate and flush water will be directed into a discharge hose to be returned to the downstream side of the screen. The discharge opening will direct screenings to the screenings dumpsters. Contractor shall relocate screening dumpster from existing headworks to new screening dumpster location.

2.06 ACCESSORIES

A. Lifting Lugs: Equipment weighting over 100 pounds shall be provided with lifting lugs.

B. Anchor Bolts: Type 316 stainless steel, sized to secure equipment, minimum 1/2 inch-diameter. See Section 05 50 00, Metal Fabrications, for requirements. Anchor bolts set by a template and protected from misalignment. Coordinate number and size with final Shop Drawings.

C. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer’s name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.07 DRIVES AND MOTORS

A. General:

1. Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 26, Electrical.
2. Instruments supplied in this Section shall be wired by either the system supplier to a common terminal junction box or by the installing electrical contractor.

B. Wiring: The Drawings and Specifications indicate the anticipated wiring for the equipment provided under this Section. If additional wiring is required, or if required wiring does not match what is indicated, the Contractor shall make the necessary modifications to the electrical wiring and documentation as part of the lump sum price. All wiring shall meet the requirements of Section 26 05 05, Conductors, and NFPA 70. All insulation shall be rated 600 volts, minimum. All low-voltage (24V) signals shall be run in twisted, shielded pair cable.

C. Electrical Raceways: All electrical wiring shall be installed in conduit meeting the requirements of Section 26 05 33, Raceway and Boxes. All raceways shall be installed in accordance with Section 26 05 33, Raceway and Boxes, and NFPA 70.

D. Motors and Speed Reducer: Motors shall meet or exceed all applicable requirements of Section 26 20 00, Low-Voltage AC Induction Motors. Load on motor shall not exceed nameplate horsepower rating under any anticipated load condition.

1. The screw shall be driven by a shaft mounted geared motor.
2. The spiral drive system will consist of a SEW-Eurodrive motor flange coupled to a SEW-Eurodrive FAF type helical gear reducer. The motor will be TEFC, 1.0 hp minimum, 1800 RPM, 230/460 volt, 3 Phase, 60 Hz, 1.15 S.F., and severe duty rated. The gear reducer will be designed in accordance with AGMA Class II service based on the horsepower required to operate the screen. The drive system shall have an output speed of 11 RPM.

2.08 CONTROLS

A. In accordance with general control requirement specified in Section 40 99 90, Package Control Systems.

B. All controls necessary for the fully automatic operation of the tank mounted spiral screen shall be provided.

C. The electrical control system shall provide for automatic control of the screen via a high liquid level using an ultrasonic liquid or pressure transducer level control system.

D. Control panel shall be suitable for outdoor, wall-mounting and outside of hazardous area. Enclosure shall be NEMA 4X 304L stainless steel with continuous hinge and lockable door latch, and shall include the following:

1. Fusible disconnect switch with door handle.
2. 480/120V ac control transformer with one (1) set of spare fuses.

3. Allen-Bradley Micro 850 or SLC500 with 5/04 interface programmable logic controller (PLC) with programmer or motor starter, relays and timers to monitor equipment mounted electrical devices to perform logic functions as required by equipment.
4. NEMA reversing motor starter and Circuit Breaker Branch Circuit Protection for screen motor.
5. Elapsed time meter.
6. Pilot lights for:
    a. Power on light [white].
    b. Screen running light [green].
    c. High level light [amber].
    d. Screen fault [red].
7. E-stop push button [red].
8. Screen reset pushbutton [black].
9. Hand-Off-Auto selector switches for the drive and spray wash.
10. Forward-Off-Reverse selector switch for the spiral drive.
11. Phenolic nameplates.
12. 600V ac terminal block.
13. Alarm horn and silencer-reset pushbutton.
14. NEMA 4X stainless steel wall-mounted enclosure.
15. Run and fault auxiliary output contacts for customer use.

E. Local Emergency Stop Pushbutton: A local emergency stop pushbutton station will be provided in a NEMA 7 enclosure for field mounting at the screen unit.

F. Interlock Switch: A safety interlock switch shall be factory mounted to the compaction and discharge zone access zone door. The interlock switch shall prevent the unit from operating while the door is open. The switch housing shall be rated NEMA 7 housing.

G. Solenoid Valve: Normally closed solenoid valve(s) shall be provided to control flow to the spray wash assemblies. The brass body valve shall be 120-volt, single phase, 60 Hz with a NEMA 7 housing.

H. SEQUENCE OF OPERATION

1. HAND OPERATION: The spiral motor and spray wash will run continuously.

2. AUTOMATIC OPERATION: The level sensor will start the unit in the forward direction. After the upstream level has been lowered, the unit will continue to run for the length of time set per the off delay timer, typically set at 30 seconds.

   Brush Saver Feature: After forward operation is complete, the unit will stop and then operate in reverse for a short duration. This momentary reversal extends brush life by preventing bristles from being laid down in only one direction. Designs without this feature are specifically excluded.

   The press zone spray wash will provide a periodic flush based on the settings of an independent repeat cycle timer.

3. EMERGENCY STOP: The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push button.
4. FAULT CONDITIONS: Motor overload or high current will stop the drive motor and illuminate the fault light.

2.09 SHOP FABRICATION

A. Stainless steel fabrications shall be cleaned and passivated following fabrication in accordance with ASTM A380. Spiral assembly, with exception to the machined drive shaft end, shall be coated with a rust inhibitive primer for protection during shipment.

B. Electric motor, speed reducers and other self-contained or enclosed equipment shall have manufacturer’s standard enamel finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s written instructions.

B. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the Drawings. Contractor shall notify Engineer of significant deviations.

C. Anchor Bolts: Accurately place using templates provided by manufacturer and as specified in Section 05 50 00, Metal Fabrications.

3.02 PAINTING

A. Touchup damaged areas of painted ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. Functional Test: Conduct on tank mounted spiral screen assembly. Test shall include 6 hours continuous operation of each screen and verification of all controls and alarms.

B. Prior to final acceptance of the screen, three tests shall be conducted according to the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-486.

C. Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

3.04 MANUFACTURER’S SERVICES

A. Manufacturer’s Representative: Present at site or classroom designated by Owner, for minimum person days listed below, travel time excluded:

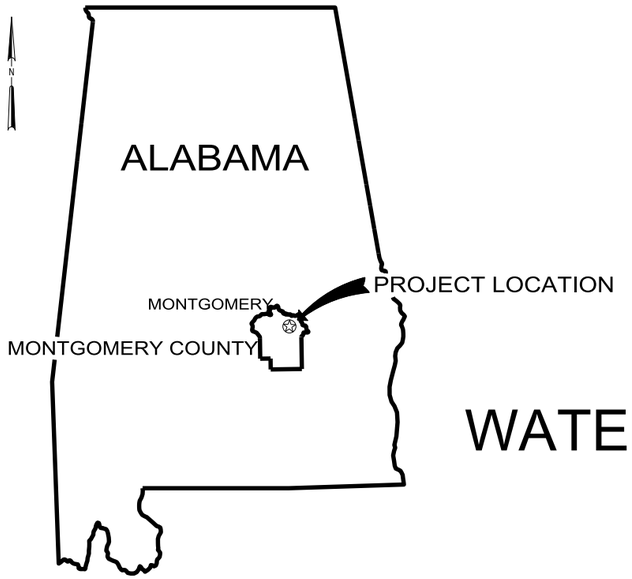
1. 1 person-day for installation assistance and inspection.
2. 1 person-day for functional and performance testing and completion of Manufacturer’s Certificate of Proper Installation.
3. 1 person-day for startup and field training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01 43 33, Manufacturers’ Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

PART 5 DRAWINGS

MILLEY'S CREEK WPCP
SCREEN REPLACEMENT



PREPARED FOR THE

WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY

VOLUME 2 OF 2
DRAWINGS

For information regarding
this project, contact:

NICK FREEMAN, P.E.
4121 CARMICHAEL RD SUITE 400
MONTGOMERY, ALABAMA 36106
(334) 215-9093

Jacobs

Project No. D3571200

JULY 2023

BID DOCUMENTS

INDEX TO DRAWINGS

SHEET NO.	DWG NO.	DESCRIPTION
GENERAL		
00	01-G-000	PROJECT COVERSHEET
01	01-G-001	INDEX OF DRAWINGS, GENERAL SYMBOLS LEGEND AND PROJECT LOCATION MAP
02	01-G-002	CIVIL LEGEND AND NOTES
03	01-G-003	STRUCTURAL GENERAL NOTES AND DESIGN CRITERIA
04	01-G-004	PROCESS MECHANICAL LEGEND
05	01-G-005	INSTRUMENTATION AND CONTROL LEGEND 1
06	01-G-006	INSTRUMENTATION AND CONTROL LEGEND 2
07	01-G-007	ELECTRICAL LEGEND 1
08	01-G-008	ELECTRICAL LEGEND 2
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09	05-Y-201	YARD PIPING PLAN
STRUCTURAL		
10	12-S-201	NEW SCREENS PLANS
11	12-S-301	NEW SCREENS SECTIONS AND DETAIL
PROCESS MECHANICAL		
12	12-D-201	HEADWORKS PLAN
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24	99-C-502	CIVIL - STANDARD DETAILS
25	99-S-501	STRUCTURAL - STANDARD DETAILS
26	99-S-502	STRUCTURAL - STANDARD DETAILS
27	99-S-503	STRUCTURAL - STANDARD DETAILS
28	99-S-504	STRUCTURAL - STANDARD DETAILS
29	99-D-501	PROCESS MECHANICAL - STANDARD DETAILS
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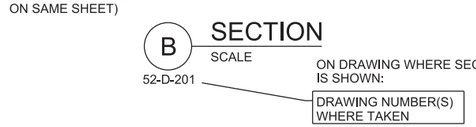
32	99-N-501	INSTRUMENTATION AND CONTROL - STANDARD DETAILS

SECTION / DETAIL DESIGNATIONS

SECTION (LETTER) OR DETAIL (NUMERAL) DESIGNATION

DRAWING NUMBER (REPLACED WITH A LINE IF TAKEN AND SHOWN ON SAME SHEET)

ON DRAWING WHERE SECTION OR DETAIL IS TAKEN: DRAWING NUMBER WHERE SHOWN



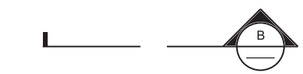
ON DRAWING WHERE SECTION IS SHOWN: DRAWING NUMBER(S) WHERE TAKEN

ON DRAWING WHERE DETAIL IS SHOWN: DRAWING NUMBER(S) WHERE TAKEN

DRAWING TITLE

SCALE

ON DRAWING WHERE ONLY A TITLE IS REQUIRED WITH NO REFERENCE (eg: ELEVATIONS)



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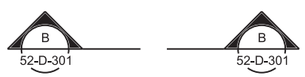


SECTION CALLOUT WHERE SECTION IS ON ANOTHER SHEET AND CUT EXTENDS THROUGHOUT ENTIRE SHEET

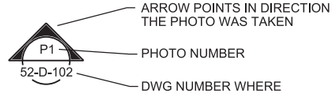
1 — GRID LINE INDICATOR

1 — KEYNOTE NUMBER

1 — REVISION / ADDENDA NUMBER

N — NORTH ARROW

PHOTO DESIGNATION



ARROW POINTS IN DIRECTION THE PHOTO WAS TAKEN

PHOTO NUMBER

DWG NUMBER WHERE PHOTO IS SHOWN

DRAWING NUMBERING LEGEND:

DISCIPLINE CODE

G	GENERAL
C	CIVIL
Y	YARD PIPING
N	INSTRUMENTATION & CONTROL
S	STRUCTURAL
A	ARCHITECTURAL
D	PROCESS MECHANICAL
E	ELECTRICAL

DESIGN DETAIL DESIGNATION

DESIGN DETAIL DESIGNATION (NUMERAL) — 1234-567

SHOWN ON DESIGN DETAIL DRAWING(S)

NOTES:

1. ALL DESIGN DETAILS ARE TYPICAL AND MUST BE USED IF DESIGN DETAIL DESIGNATION IS NOT SHOWN
2. THE TERM STANDARD DETAIL, OR A FORM OF IT, IS SYNONYMOUS WITH DESIGN DETAIL. THE DESIGN DETAILS REPRESENT THE CHARACTER AND NATURE OF THE WORK REQUIRED THROUGHOUT THE PROJECT. ALL ASSOCIATED WORK SHALL BE IN ACCORDANCE WITH THE DESIGN DETAILS SHOWN WHETHER THE DETAILS ARE SPECIFICALLY REFERENCED OR NOT.

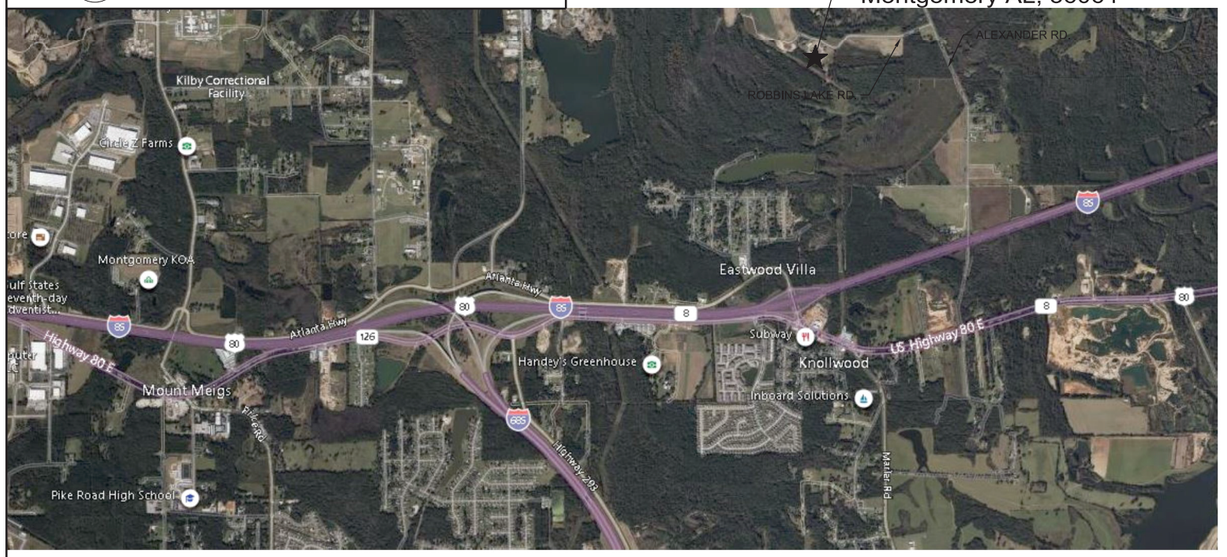
GENERAL NOTE:

1. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

ALABAMA LICENSED — Nicholas D Freeman — No. 33222 — PROFESSIONAL ENGINEER — NICHOLAS D. FREEMAN

Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
Date: 2023.07.19 13:09:54 -05'00'

Milley's Creek WPCP
1493 Alexander Road, Pike Road
Montgomery AL, 36064



N

VICINITY MAP

NTS

	APVD	N FREEMAN	
	BY	N FREEMAN	
	REVISION	KL DIAZ	
	CHK	T GRISWELL	
	DR		
	DATE		
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	DSGN		

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL
INDEX OF DRAWINGS, GENERAL SYMBOLS LEGEND AND PROJECT LOCATION MAP

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-001
SHEET	01 of 32

GENERAL SITE NOTES:

1. SOURCE OF EXISTING FEATURES SHOWN ON THE CIVIL PLANS ARE FROM RECORD DRAWINGS. EXISTING CONDITIONS VARY FROM THOSE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND ADJUST WORK PLAN ACCORDINGLY PRIOR TO BEGINNING CONSTRUCTION.
2. EXISTING STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED UNLESS OTHERWISE STATED.
3. NEW FINISH GRADE, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED.
4. HORIZONTAL DATUM: NAD83. ALABAMA STATE PLANE EAST, US SURVEY FEET.
5. VERTICAL DATUM: NAVD88.
6. MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTOR'S EXPENSE.
7. COORDINATE WITH OWNER FOR ALLOWED STAGING AREA. STAGING AREA SHALL BE FOR CONTRACTOR'S EMPLOYEE PARKING, CONTRACTOR'S TRAILERS AND ON-SITE STORAGE OF MATERIALS.
8. PROVIDE TEMPORARY FENCING AS NECESSARY TO MAINTAIN SECURITY AT ALL TIMES.
9. GROUND ELEVATIONS GIVEN ARE TO FINISH GRADE UNLESS OTHERWISE SHOWN.
10. SLOPE UNIFORMLY BETWEEN CONTOURS AND SPOT ELEVATIONS SHOWN.

GENERAL YARD PIPING AND UTILITIES NOTES:

1. EXISTING UNDERGROUND UTILITIES OBTAINED FROM RECORD DRAWINGS. ALL EXISTING UNDERGROUND UTILITIES ARE NOT SHOWN THEREFORE CONTRACTOR SHALL FIELD VERIFY DEPTH AND LOCATION PRIOR TO EXCAVATION. PROTECT ALL EXISTING UTILITIES DURING CONSTRUCTION.
2. FOR PIPING FLOW STREAM IDENTIFICATION, SEE DRAWING 01-G-006.
3. EXISTING PIPING AND EQUIPMENT ARE SHOWN SCREENED AND/OR LIGHT-LINED. NEW PIPING AND EQUIPMENT ARE SHOWN HEAVY-LINED. (WITH THE EXCEPTION OF THE DEMOLITION DRAWINGS)
4. UNLESS OTHERWISE SHOWN ALL PIPING SHALL HAVE A MINIMUM OF 3 FEET COVER.
5. ALL PIPES SHALL HAVE A CONSTANT SLOPE BETWEEN INVERT ELEVATIONS UNLESS SHOWN DIFFERENTLY.
6. ALL NEW WATER PIPES MUST BE PROPERLY FLUSHED, PRESSURE TESTED, CHLORINATED AND BACTERIOLOGICALLY TESTED, AS SPECIFIED.
7. FOR TRENCHING AND BACKFILL, SEE (3123-110) .
8. FOR SURFACE RESTORATION, SEE (3123-115).
9. FOR CONCRETE TO EXISTING CONCRETE, SEE (3123-245) .

EROSION AND SEDIMENT CONTROL NOTES

1. CONTRACTOR TO PREPARE AND SUBMIT A PROJECT SPECIFIC CONSTRUCTION BEST MANAGEMENT PRACTICE PLAN (CBMPP) PREPARED BY A QUALIFIED PROFESSIONAL (QCP).
2. CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING AND MAINTAINING EROSION CONTROL DEVICES DURING CONSTRUCTION.
3. CONTRACTOR TO SUBMIT AND OBTAIN APPROVAL FOR THE CONSTRUCTION BEST MANAGEMENT PRACTICES PLAN (CBMPP) AND NOTICE OF INTENT (NOI) FOR A NPDES CONSTRUCTION GENERAL PERMIT.
4. CONTRACTOR SHALL IMPLEMENT EROSION CONTROL MEASURES IN ACCORDANCE WITH THE ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORM WATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS. IF ADDITIONAL EROSION CONTROL MEASURES ARE REQUIRED TO PREVENT OFF SITE MIGRATION OF STORM WATER RUNOFF, THE CONTRACTOR SHALL INFORM THE OWNER AND ENGINEER AND IMPLEMENT ADDITIONAL CONTROL MEASURES AS REQUIRED.
5. STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICABLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN 10 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED.
6. STRUCTURAL PRACTICES SHALL BE IMPLEMENTED TO DIVERT FLOWS FROM EXPOSED SOILS AND STORM DRAINS OR OTHERWISE LIMIT RUNOFF AND THE DISCHARGE OF POLLUTANTS FROM EXPOSED AREAS OF THE SITE TO THE DEGREE ATTAINABLE. SUCH PRACTICES MAY INCLUDE SILT FENCES, EARTH DIKES, DRAINAGE SWALES, SEDIMENT TRAPS, CHECK DAMS, AND STORM DRAIN INLET PROTECTION. STRUCTURAL PRACTICES SHOULD BE PLACED ON UPLAND SOILS TO THE DEGREE ATTAINABLE.
7. LOCAL, STATE AND MANUFACTURER'S METHODS FOR SPILL CLEANUP WILL BE CLEARLY POSTED AND PROCEDURES WILL BE MADE AVAILABLE TO SITE PERSONNEL. MATERIAL AND EQUIPMENT NECESSARY FOR SPILL CLEANUP WILL BE KEPT IN THE MATERIAL STORAGE AREAS. TYPICAL MATERIALS AND EQUIPMENT INCLUDES, BUT IS NOT LIMITED TO BROOMS, DUSTPANS, MAPS, RAGS, GLOVES, GOGGLES, CAT LITTER, SAND, SAWDUST AND PROPERLY LABELED PLASTIC AND METAL WASTE CONTAINERS. SPILLS WILL BE CLEANED UP IMMEDIATELY. ALL SPILLS WILL BE REPORTED AS REQUIRED BY LOCAL, STATE AND FEDERAL REGULATIONS.
8. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES UNTIL PERMANENT STABILIZATION OF THE SITE IS ACHIEVED. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CHECKED AFTER EACH RAIN EVENT, AND SHALL BE IMMEDIATELY REPAIRED OR REPLACED IF FOUND TO BE DEFECTIVE.
9. DEWATERING DISCHARGE TO A SEDIMENT FILTER BAG ON THE END OF THE DISCHARGE UPSTREAM OF A VEGETATED SWALE.

CIVIL LEGEND

EXISTING	THIS CONTRACT	
× 157.7	⊗ 158.5	SPOT ELEVATION
155	155	CONTOUR LINE
	3:1	EMBANKMENT AND SLOPE
		DRAINAGEWAY OR DITCH
		CATCH BASIN OR INLET
		TRENCH DRAIN
	OR	SIGN
	Ⓓ OR Ⓢ	MANHOLE
E	E	ELECTRICAL MANHOLE
H	E	ELECTRIC HANDHOLE
		POST OR GUARD POST
		GUY ANCHOR
		FIRE HYDRANT
		UTILITY POLE
		LIGHT POLE
	⚬ BM	BENCH MARK
	△	SURVEY CONTROL POINT OR POINT OF INTERSECTION
		BRUSH/TREE LINE
		TREE
		PROPERTY LINE
		CENTER LINE, BUILDING, ROAD, ETC.
		STAGING OR WORK AREA LIMITS
N 1000.00 E 1000.00		STRUCTURE, BUILDING OR FACILITY LOCATION POINT - COORDINATES
	B-1	BORING LOCATION AND NUMBER
	TP-2	TEST PIT LOCATION AND NUMBER
	P-3	PIEZOMETER LOCATION AND NUMBER
OR	OR	DEMOLITION
OR	OR	STRUCTURE, BUILDING OR FACILITY
		ASPHALT CONCRETE PAVEMENT
		GRAVEL SURFACING
CONC.		CONCRETE PAVEMENT / SIDEWALK
		CURB
		CURB AND GUTTER
		VALLEY GUTTER
		SINGLE SWING GATE
		DOUBLE SWING GATE
		SLIDING GATE
		CHAIN LINK FENCE
		ARCHITECTURAL FENCE
		SILT FENCE
		CULVERT
EX		EXISTING BURIED ELECTRIC

GENERAL NOTE:

1. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

ALABAMA LICENSED ENGINEER
Nicholas D Freeman
No. 33222
PROFESSIONAL
ENGINEER
NICHOLAS D. FREEMAN

Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
2023.07.19 16:10:56 -05'00'

DEMOLITION NOTES

1. DEMOLITION OF EXISTING FEATURES OR STRUCTURES SHALL INCLUDE COMPLETE REMOVAL AND DISPOSAL OF ANY MATERIALS ENCOUNTERED.
2. THE OWNER HAS FIRST RIGHT OF REFUSAL FOR ITEMS TO BE DEMOLISHED.

YARD PIPING LEGEND

EXISTING	THIS CONTRACT	
	8" PE	NOMINAL PIPE DIAMETER
	8" PE	PIPE USE IDENTIFICATION
8" PE		PIPING < 30" DIAMETER
		PIPING ≧ 30" DIAMETER
		EXISTING PIPE TO BE ABANDONED
		EXISTING PIPE TO BE REMOVED
		NON-FREEZE HOSE VALVE (V-X) X = NO. IN SPECIFICATIONS
		NON-FREEZE HOSE VALVE WITH HOSE RACK (V-X) X = NO. IN SPECIFICATIONS
		INDICATOR POST VALVE
		GATE VALVE AND VALVE BOX
		BUTTERFLY VALVE AND VALVE BOX
		PLUG VALVE AND VALVE BOX
		FLEXIBLE COUPLING
		90° ELBOW UP
		90° ELBOW DOWN
		BEND < 90° UP
		BEND < 90° DOWN
		CONCENTRIC REDUCER
		CAP OR PLUG
		CLEANOUT
		FIRE HYDRANT

NO.	DSGN	DATE	BY	REVISION	CHK	APVD
	M LAKEMAN		KL DIAZ		N FREEMAN	N FREEMAN
	DR		CHK		APVD	BY

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL
CIVIL LEGEND AND NOTES

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-002
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BID DOCUMENTS

DESIGN CRITERIA

1. APPLICABLE CODE: **2021** INTERNATIONAL BUILDING CODE (IBC), AS AMENDED BY THE APPLICABLE LOCAL AGENCIES.

2. REFER TO THE DRAWINGS FOR ADDITIONAL AND SPECIFIC STRUCTURE LOADINGS AND REQUIREMENTS.

3. ALL LOADS SHOWN ARE SERVICE LEVEL (UNFACTORED) UNLESS SPECIFICALLY NOTED OTHERWISE.

4. DEAD LOADS:
   A. SELF WEIGHT
   B. COLLATERAL:°
      MECHANICAL, ELECTRICAL AND PLUMBING UTILITIES = 10 PSF OR 300 LBS CONCENTRATED LOAD AT MID-SPAN OR LOCATION TO PRODUCE MAXIMUM FLEXURAL AND SHEAR EFFECT ON MEMBER

5. ROOF LOADS:

GROUND SNOW LOAD, Pg	= 5 PSF
SNOW EXPOSURE FACTOR, Ce	= 1.0
THERMAL FACTOR, Ct	= 1.2
SLOPE FACTOR, Cs	= 1.0
IMPORTANCE FACTOR, I	= 1.1
FLAT ROOF SNOW LOAD, Pf	= 4.6 PSF
MINIMUM FLAT ROOF SNOW LOAD	= 5.5 PSF
LIVE LOAD	= 20 PSF

   ROOF LIVE REDUCTION SHALL NOT BE USED

   DEFLECTION CRITERIA FOR CONTRACTOR DESIGNED ROOF FRAMING MEMBERS:

TOTAL LOAD	L/240
LIVE LOAD	L/360
SNOW LOAD	L/360

6. FLOOR LIVE LOADS:

TYPICAL, UON	100 PSF
STAIRS, WALKWAYS AND PLATFORMS	100 PSF
VEHICLE ACCESS	AASHTO HS 20

7. WIND LOADS:

ASCE 7 METHOD	= ALL HEIGHTS MWFRS DIRECTIONAL PROCEDURE
BASIC WIND SPEED (3-SECOND GUST)	= 119 MPH
RISK CATEGORY	= III
EXPOSURE CATEGORY	= C
INTERNAL PRESSURE COEFFICIENT, GCpi	NOT APPLICABLE
COMPONENTS AND CLADDING DESIGN WIND PRESSURES	NOT APPLICABLE

8. SEISMIC LOADS:

RISK CATEGORY	= III
SEISMIC IMPORTANCE FACTOR, Ie	=1.25
MAPPED SPECTRAL RESPONSE ACCELERATIONS	
S_s	= 0.125g
S_1	= 0.074g
DESIGN SPECTRAL RESPONSE ACCELERATIONS	
S_{DS}	= 0.134g
S_{D1}	= 0.118g
SITE CLASS	= D (ASSUMED)
SEISMIC DESIGN CATEGORY	= B
BASIC SEISMIC FORCE - RESISTING SYSTEM(S)	= STEEL SYSTEM NOT SPECIFICALLY DETAILED FOR SEISMIC RESISTANCE
SEISMIC RESPONSE COEFFICIENT(S), Cs	= 0.056
RESPONSE MODIFICATION COEFFICIENT(S), R	= 3

   STRUCTURES HAVE BEEN ANALYZED USING THE EQUIVALENT LATERAL FORCE PROCEDURES OF ASCE 7-16, UON.

9. SOIL DESIGN PARAMETERS:

A. ALLOWABLE SOIL BEARING PRESSURES:	1500 PSF
B. GROUND WATER (GW) ELEVATION	SEE EXISTING GEOTECHNICAL REPORT

10. FROST DEPTH: 6 IN

11. ICE LOADS:

A. NOMINAL ICE THICKNESS:	1 IN
B. CONCURRENT WIND SPEED (3-SECOND GUST):	40 MPH
C. ICE IMPORTANCE FACTOR THICKNESS:	1.15
D. ICE IMPORTANCE FACTOR WIND:	1.00

GENERAL INFORMATION

1. FOR ABBREVIATIONS NOT LISTED, SEE ASME Y14.38 "ABBREVIATIONS AND ACRONYMS: PUBLICATION AS DISTRIBUTED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME).

2. DESIGN DETAILS ARE INTENDED TO BE TYPICAL AND SHALL APPLY TO SIMILAR SITUATIONS OCCURRING THROUGHOUT THE PROJECT, WHETHER OR NOT THEY ARE INDIVIDUALLY CALLED OUT.

3. VERIFY FINAL OPENING DIMENSIONS IN WALLS, SLABS, AND DECKS WITH OTHER DISCIPLINE DRAWINGS PRIOR TO CONSTRUCTION OF THESE ELEMENTS.

4. FOR NUMBER, TYPE, SIZE, ARRANGEMENT, AND/OR LOCATION OF EQUIPMENT PADS, SEE OTHER DISCIPLINE DRAWINGS. COORDINATE WITH EQUIPMENT SUPPLIER PRIOR TO PLACING SLABS, WALLS AND FOUNDATIONS. COORDINATE PIPING OPENINGS WITH OTHER DISCIPLINE DRAWINGS.

5. DO NOT CUT OR MODIFY STRUCTURAL MEMBERS FOR PIPES, DUCTS, ETC, UNLESS SPECIFICALLY DETAILED OR APPROVED IN WRITING BY THE ENGINEER.

6. VISITS TO THE JOB SITE BY THE ENGINEER TO OBSERVE THE CONSTRUCTION DO NOT IN ANY WAY MEAN THAT ENGINEER IS GUARANTOR OF CONSTRUCTOR'S WORK, NOR RESPONSIBLE FOR THE COMPREHENSIVE OR SPECIAL INSPECTIONS, COORDINATION, SUPERVISION, OR SAFETY AT THE JOB SITE.

7. INFORMATION (DETAILING, DIMENSIONS, CONFIGURATIONS, AND ELEVATIONS, ETC.) OF EXISTING CONSTRUCTION SHOWN REFLECTS AVAILABLE EXISTING DESIGN DOCUMENTS, AND DOES NOT NECESSARILY REPRESENT THE AS-CONSTRUCTED CONDITIONS. THE CONTRACTOR SHALL FIELD VERIFY DIMENSIONS, ELEVATIONS AND DETAILING OF THE EXISTING STRUCTURES PRIOR TO UNDERTAKING ANY WORK THAT IS AFFECTED BY THE EXISTING STRUCTURE. NOTIFY ENGINEER IF CONDITIONS VARY FROM THAT SHOWN PRIOR TO STARTING WORK.

INSPECTION AND TESTING

1. SPECIAL INSPECTION DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY FOR INSPECTIONS REQUIRED BY THE BUILDING OFFICIAL. THE CONTRACTOR SHALL SCHEDULE BOTH INSPECTIONS.

2. SPECIFIED CONCRETE AND OTHER MATERIAL TESTING RELATED TO SPECIAL INSPECTION DURING CONSTRUCTION WILL BE OWNER FURNISHED.

3. SPECIFIED LABORATORY TEST MIXES AND SIMILAR TEST RESULTS TO VERIFY MATERIAL QUALITY AND CONFORMANCE TO SPECIFICATIONS, AND SUBMITTED FOR REVIEW PRIOR TO ACCEPTANCE FOR USE ON THE PROJECT, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

4. SPECIAL INSPECTION, TESTING AND OBSERVATION (OWNER FURNISHED) IS REQUIRED IN ACCORDANCE WITH IBC SECTIONS 110 AND 1704 AS INDICATED IN THE STATEMENT OF SPECIAL INSPECTIONS IN SPECIFICATION 01 45 33 SPECIAL INSPECTION, OBSERVATION AND TESTING.

FOUNDATIONS

1. REFER TO REPORT 'GEOTECHNICAL INVESTIGATION FOR THE PROPOSED MILLEY'S CREEK WPCP' PREPARED BY CH2MHILL DATED JULY 2009.

2. EXCAVATIONS SHALL BE SHORED TO PREVENT SUBSIDENCE AND DAMAGE TO ADJACENT EXISTING STRUCTURES, ROADS, UTILITIES, ETC.

3. SEE DRAWINGS AND GEOTECHNICAL REPORT FOR FOUNDATION SUBGRADE INFORMATION.

4. FOUNDATION BEARING SURFACES SHALL BE OBSERVED BY THE GEOTECHNICAL ENGINEER OR QUALIFIED DESIGNEE PRIOR TO PLACEMENT OF FORMWORK OR REINFORCING STEEL. THE OBSERVATION SHALL VERIFY IF THE ACTUAL EXPOSED SUBGRADE IS AS ANTICIPATED BY THE SITE SPECIFIC BORINGS AND DATA REPORTS.

5. USE OF EXPLOSIVES IS ONLY ALLOWED WITH WRITTEN PERMISSION FROM ENGINEER.

FORMWORK, SHORING, AND BRACING

1. STRUCTURES SHOWN ON THE DRAWINGS HAVE BEEN DESIGNED FOR STABILITY UNDER FINAL CONDITIONS ONLY. DESIGN SHOWN DOES NOT INCLUDE NECESSARY COMPONENTS OR EQUIPMENT FOR STABILITY OF THE STRUCTURES DURING CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR WORK RELATING TO CONSTRUCTION ERECTION METHODS, BRACING, SHORING, RIGGING, GUYS, SCAFFOLDING, FORMWORK, AND OTHER WORK AIDS REQUIRED TO SAFELY PERFORM THE WORK SHOWN.

CONCRETE REINFORCING

1. REINFORCING STEEL:
   TYPICAL: ASTM A615, GRADE 60

2. FABRICATION AND PLACEMENT OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CRSI MSP-1 "MANUAL OF STANDARD PRACTICE" AND ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE".

3. CONCRETE COVER FOR REINFORCING, UNLESS SHOWN OTHERWISE, SHALL BE:

WHEN CAST AGAINST EARTH:	3"
TYPICAL, UNLESS OTHERWISE NOTED:	2"

4. REFER TO WALL CORNER AND WALL INTERSECTION REINFORCING DETAIL 0330-003. WALL CORNER REINFORCING SIZES AND SPACINGS SHALL BE AS SHOWN ON THE DRAWINGS AND REFERENCED TO THIS DETAIL. TYPICAL HORIZONTAL WALL REINFORCING SHALL LAP WITH THE CORNER HORIZONTAL REINFORCING.

5. 90 DEGREE BENDS, UNLESS OTHERWISE SHOWN, SHALL BE ACI 318 STANDARD HOOKS IN ACCORDANCE TO TABLE 25.3.1 OR SECTION 25.3.4 OF ACI 318-14.

6. REINFORCING STEEL FOR FOOTINGS AND SLABS ON GRADE SHALL BE ADEQUATELY SUPPORTED ON BAR SUPPORTS WITH SPACERS TO KEEP REINFORCING ABOVE THE PREPARED GRADE. LIFTING REINFORCING OFF GRADE DURING CONCRETE PLACEMENT IS NOT PERMITTED.

7. REFER TO OPENING REINFORCING DETAILS 0330-001 AND 0330-002.

8. PROVIDE #4x4'-0" LG BARS AT ALL RE-ENTRANT CORNERS. PLACE 2" (+1/2") CLR FROM TOP OF SLAB.

9. REINFORCEMENT BENDS AND LAPS, UNLESS OTHERWISE NOTED, SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS:

CONCRETE DESIGN STRENGTH = 4,000 PSI MIN AT 28 DAYS[3] GRADE 60 REINFORCING STEEL										
BAR SIZE		#3	#4	#5	#6	#7	#8	#9	#10	#11
LAP SPLICE LENGTH										
SPACING = 3"	TOP BAR [2]	1'-4"	1'-8"	2'-1"	3'-0"	5'-2"	6'-8"	8'-6"	10'-10"	13'-4"
	OTHER BAR	1'-4"	1'-4"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"
SPACING = 4"	TOP BAR [2]	1'-4"	1'-8"	2'-0"	2'-5"	3'-10"	5'-0"	6'-5"	8'-1"	10'-0"
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
SPACING ≥ 6"	TOP BAR [2]	1'-4"	1'-8"	2'-0"	2'-5"	3'-6"	4'-0"	5'-0"	6'-2"	7'-5"
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"
EMBEDMENT LENGTH										
SPACING = 3"	TOP BAR [2]	1'-0"	1'-3"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-10"	3'-1"	4'-0"	5'-1"	6'-5"	7'-11"
SPACING = 4"	TOP BAR [2]	1'-0"	1'-3"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-4"	3'-0"	3'-10"	4'-10"	5'-11"
SPACING ≥ 6"	TOP BAR [2]	1'-0"	1'-3"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-1"	2'-5"	3'-0"	3'-8"	4'-5"

1. LAP LENGTHS ARE BASED ON MINIMUM CONCRETE COVER OF 2". LONGER LENGTHS ARE REQUIRED FOR CONCRETE COVER LESS THAN 2".
2. TOP BARS SHALL BE DEFINED AS ANY HORIZONTAL BARS PLACED SUCH THAT MORE THAN 12 INCHES OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR IN ANY SINGLE POUR. HORIZONTAL WALL BARS ARE CONSIDERED TOP BARS.
3. WHERE 3000 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 16 PERCENT. WHERE 3500 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 7 PERCENT.

CAST IN PLACE CONCRETE

1. 28-DAY COMPRESSIVE STRENGTHS (TO MEET STRUCTURAL STRENGTH REQUIREMENTS);

TYPICAL, UNLESS OTHERWISE NOTED:	5000PSI (CMD-1)
DUCT BANKS AND PIPE ENCASEMENTS:	4000PSI (CMD-2)
CURBS AND SIDEWALKS	5000PSI (CMD-3)

   SEE SPECIFICATION FOR CONCRETE MIX DESIGN (CMD) INFORMATION.

2. DESIGN STRENGTHS ARE SAME AS 28-DAY COMPRESSIVE STRENGTHS.

3. CONTINUOUS WATERSTOP AS SPECIFIED SHALL BE INSTALLED IN CONSTRUCTION JOINTS OF HYDRAULIC STRUCTURES, CHANNELS, AND BELOW GRADE STRUCTURES, EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE.

4. COORDINATE PLACEMENT OF OPENINGS, PIPE PENETRATIONS, CURBS, DOWELS, SLEEVES, CONDUITS, BOLTS AND INSERTS PRIOR TO PLACEMENT OF CONCRETE.

ALABAMA LICENSED No. 42218 PROFESSIONAL ENGINEER KENNETH MICHAEL DANE
11/20/2023

WELDING

1. WELDS SHALL CONFORM TO AMERICAN WELDING SOCIETY (AWS): D1.1, STRUCTURAL WELDING CODE STEEL

2. REPAIR WELDS FOUND DEFECTIVE IN ACCORDANCE WITH AWS D1.1 SECTION 5.26.

3. USE INTERMITTENT WELDS AT FIELD WELDS OF EMBED PLATES AND ANGLES TO AVOID SPALLING OR CRACKING OF THE EXISTING CONCRETE.

4. BUTT JOINT WELDS SHALL BE COMPLETE JOINT PENETRATION (CJP) UNLESS INDICATED OTHERWISE.

STRUCTURAL STEEL AND METAL FABRICATIONS

1. STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:

W-SHAPES	A992
MISCELLANEOUS SHAPES INCLUDING ANGLES, CHANNELS, PLATES, ETC.	A36
HOLLOW STRUCTURAL SECTIONS (HSS)	A500, GRADE B
STEEL PIPE	A53, GRADE B
STAINLESS STEEL SHAPES	A276

2. ALUMINUM SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:

STRUCTURAL SHAPES	B308
PLATES	B209

3. STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN CONFORMANCE WITH THE AISC MANUAL OF STEEL CONSTRUCTION, CURRENT EDITION, AND CURRENT OSHA STANDARDS.

4. FASTENERS SHALL BE HIGH STRENGTH BOLTS CONFORMING TO THE FOLLOWING ASTM STANDARDS EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE:

UNLESS SHOWN OTHERWISE	A325-N
ANCHOR BOLTS (AB)	
STAINLESS STEEL	F593, AISI TYPE 316, CONDITION CW
STEEL OR GALVANIZED STEEL	F1554, GR 36 / A153
MACHINE BOLTS (MB)	
STEEL	A307
STAINLESS STEEL	F593, AISI TYPE 316, CONDITION CW
GALVANIZED STEEL	A307 / A153
ALUMINUM	F468, ALLOY 2024-T4

5. ITEMS TO BE EMBEDDED IN CONCRETE SHALL BE CLEAN AND FREE OF OIL, DIRT AND PAINT.

6. NO HOLES OTHER THAN THOSE SPECIFICALLY DETAILED SHALL BE ALLOWED THROUGH STRUCTURAL STEEL MEMBERS. NO CUTTING OR BURNING OF STRUCTURAL STEEL IS PERMITTED WITHOUT THE APPROVAL OF THE ENGINEER.

DEFERRED SUBMITTALS

1. DEFERRED SUBMITTALS ARE THOSE PORTIONS OF THE DESIGN WHICH ARE NOT SUBMITTED AT THE TIME OF PERMIT APPLICATION AND WHICH ARE TO BE SUBMITTED TO THE PERMITTING AGENCY FOR ACCEPTANCE PRIOR TO INSTALLATION OF THAT PORTION OF THE WORK OR ARE REQUIRED TO BE SUBMITTED FOR REVIEW ONLY BY THE ENGINEER.

2. WHERE DEFERRED SUBMITTALS INCLUDE ADDITIONAL MATERIALS, INSTALLATION, ANCHORAGE, OR CERTIFICATION OF COMPONENTS THAT REQUIRE SPECIAL INSPECTION AND/OR STRUCTURAL OBSERVATION TO MEET CODE REQUIREMENTS, THE DEFERRED SUBMITTAL SHALL INCLUDE SPECIFIC LINE ITEMS TO BE ADDED TO THE APPROPRIATE TABLES IN THE PROJECT'S STATEMENT OF SPECIAL INSPECTIONS PLAN IF THEY ARE NOT ALREADY IDENTIFIED.

3. THE FOLLOWING IS A LIST OF DEFERRED SUBMITTALS PER IBC SECTION 107.3.4.1 OF IBC 2021 THAT ARE EXPECTED TO CONTAIN STRUCTURAL CALCULATIONS OR SAFETY RELATED SYSTEM INFORMATION FOR REVIEW TO MEET BUILDING PERMITTING REQUIREMENTS FOR DESIGNED SYSTEMS. PRIOR TO INSTALLATION OF THE INDICATED STRUCTURAL ELEMENT, EQUIPMENT, DISTRIBUTION SYSTEM, OR COMPONENT OR ITS ANCHORAGE, THE CONTRACTOR SHALL SUBMIT THE REQUIRED CALCULATIONS AND SUPPORTING DATA AND DRAWINGS FOR REVIEW AND ACCEPTANCE BY THE ENGINEER. ADDITIONALLY, ACCEPTANCE INDICATED ON THE ENGINEER'S COMMENT FORM, ALONG WITH THE COMPLETED, FINAL SUBMITTAL SHALL THEN BE SUBMITTED BY THE CONTRACTOR TO THE PERMITTING AGENCY AND APPROVED PRIOR TO INSTALLATION OF THESE ITEMS.

SPECIFICATION SECTION	CODE REQUIRED DEFERRED SUBMITTALS FOR REVIEW BY PERMITTING AGENCY
01 88 15	ANCHORAGE AND BRACING
05 52 16	ALUMINUM RAILINGS
OTHER	ANY EQUIPMENT OR COMPONENT IN WHICH A TECHNICAL SPECIFICATION REQUIRES SUBMITTAL OF EQUIPMENT OR ANCHORAGE SYSTEM CALCULATIONS

NO.	DATE	DSGN	DR	CHK	REVISION	BY	APVD
		E ALMANASEER	A KONIOR	G PETTY		K DANE	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL

STRUCTURAL GENERAL NOTES AND DESIGN CRITERIA

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	JULY 2023
PROJ	D3571200
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BID DOCUMENTS

PIPE AND FITTING SYMBOLS

DOUBLE LINE	SINGLE LINE	
		EXISTING PIPE
		NEW PIPE
		ABANDONED PIPE
		EXISTING PIPE TO BE REMOVED
		WELDED JOINT
		FLANGED JOINT (OR GROOVED WHERE SPECIFICALLY NOTED)
		MECHANICAL JOINT & PROPRIETARY RESTRAINED JOINT
		BELL & SPIGOT JOINT (LEADED)
		HUB & SPIGOT JOINT (RUBBER GASKET)
		BALL JOINT
		FLANGED COUPLING ADAPTER
		FLEXIBLE COUPLING
		METAL BELLOWS EXP JOINT
		ELASTOMER BELLOWS EXP JOINT
		ELBOW UP
		ELBOW DOWN
		TEE UP
		TEE DOWN
		CARBON STEEL FLANGED JOINT

DOUBLE LINE	SINGLE LINE	
		LATERAL UP
		LATERAL DOWN
		CONCENTRIC REDUCER
		ECCENTRIC REDUCER
		REDUCING BUSHING
		UNION
		CAP
		ANCHOR
		ELBOW, 90 DEGREE
		CROSS
		TEE
		ELBOW, 45 DEGREE
		LATERAL

NOTES:

1. ONLY FLANGED END CONNECTIONS ARE SHOWN HERE FOR DOUBLE LINE FITTINGS. FITTINGS WITH OTHER END PATTERNS ARE SHOWN SIMILARLY ON THE CONSTRUCTION DRAWINGS. ALSO SEE SECTION 40 27 00.
2. SYMBOLS SHOWN HERE FOR SINGLE LINE FITTINGS ARE GENERIC ONLY. REFER TO PIPING SPECIFICATIONS FOR SPECIFIC END CONNECTIONS FOR SINGLE LINE PIPE AND FITTINGS.
3. EXISTING PIPE AND EQUIPMENT IS SHOWN LIGHT-LINED AND/OR SCREENED AND IS NOTED AS EXISTING. NEW PIPING AND EQUIPMENT IS SHOWN HEAVY-LINED.

VALVE SYMBOLS

SINGLE LINE	DOUBLE LINE
	GATE
	BUTTERFLY
	OR
	GLOBE
	BALL
	PLUG
	NEEDLE
	DIAPHRAGM
	SWING CHECK

HOSE VALVE (HV- X) OR (V-X)
X = NO. IN SPECS

SAMPLE

MUD

PRESSURE RELIEF

AIR AND/OR VACUUM RELEASE

REGULATED SIDE

PRESSURE CONTROL (INTERNAL PILOT)

REGULATED SIDE

PRESSURE CONTROL (EXTERNAL PILOT)

MULTI-PORT VALVE,
ARROWS INDICATE FLOW PATTERN.
SEATING PORTS ARE IMPLIED BY
INDICATED FLOW PATTERN.

TELESCOPING SCUM VALVE

Nicholas D Freeman
ALABAMA LICENSED
No. 33222
PROFESSIONAL ENGINEER
NICHOLAS D. FREEMAN
Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
2023.07.19 16:11:05 -05'00'

VALVE DESIGNATIONS

MANUAL VALVES AND CHECK VALVES

16"-V405

VALVE SIZE

VALVE TYPE, SEE SECTION 40 27 02 FOR TYPE DEFINITION

CONTROL VALVES

NOTE: SEE I&C LEGEND SHEETS FOR TAGGING REQUIREMENTS. SEE VALVE SCHEDULE.

SELF-CONTAINED REGULATING VALVES

NOTE: SEE I&C LEGEND SHEETS FOR TAGGING REQUIREMENTS. SEE VALVE SCHEDULE.

PIPING SERVICE DESIGNATION

EXAMPLE:

16" WAS

16" WAS

SERVICE- SEE I&C LEGEND SHEETS OR PIPING SCHEDULE FOR ABBREVIATION MEANING

NOMINAL PIPE DIAMETER

OTHER SYMBOLS

PIPE TERMINATION

APPROXIMATE GRADE ELEVATION

MECHANICAL LEGEND AND NOTES

1. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
2. SIZE OF FITTINGS SHOWN ON DRAWINGS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
3. LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS SHOWN IS ONLY APPROXIMATE. CONTRACTOR SHALL DESIGN SUPPORTS AS SPECIFIED.
4. ALL JOINTS SHALL BE WATERTIGHT. WALL PIPES SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL.
5. ALL FLEXIBLE CONNECTORS AND COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
6. SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE DRAWINGS, WHEREVER APPLICABLE. NOT ALL OF THE VARIOUS PIPING COMPONENTS ARE NECESSARILY USED IN THE PROJECT.
7. PRIOR TO LEAKAGE TESTING, PIPE TO BE FULLY RESTRAINED.
8. NUMBER AND LOCATION OF UNIONS SHOWN ON DRAWINGS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
9. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.

NO.	DATE	DSGN	DR	CHK	APVD
REVISION			M LAKEMAN	KL DIAZ	N FREEMAN
BY					APVD
N FREEMAN					

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL

PROCESS MECHANICAL LEGEND

VERIFY SCALE

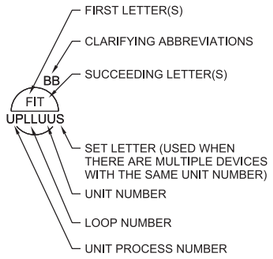
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-004
SHEET	04 of 32

BID DOCUMENTS

INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS



DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- $\triangle_X$ DISCRETE INPUT
- ∇_X DISCRETE OUTPUT

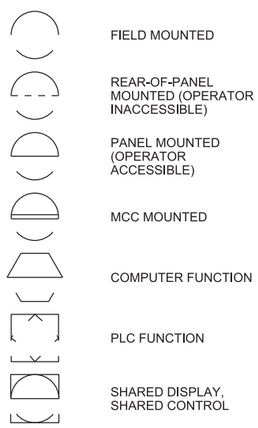
INSTRUMENT IDENTIFICATION LETTERS TABLE

LETTER	FIRST-LETTER: PROCESS OR INITIATING VARIABLE	FIRST-LETTER: MODIFIER	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION
A	ANALYSIS (+)		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
C	USER'S CHOICE (*)			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT, SENSOR		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE (*)		GLASS, GAUGE VIEWING DEVICE	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
O	USER'S CHOICE (*)		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTI FUNCTION	MULTI FUNCTION	MULTI FUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED (*)	X AXIS	UNCLASSIFIED (*)	UNCLASSIFIED (*)	UNCLASSIFIED (*)
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION	Z AXIS		DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

TABLE BASED ON THE INTERNATIONAL SOCIETY OF AUTOMATION (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.
(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT.

GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS



TRANSDUCERS

A	ANALOG	I	CURRENT
D	DIGITAL	P	PNEUMATIC
E	VOLTAGE	PF	PULSE FREQUENCY
F	FREQUENCY	PD	PULSE DURATION
H	HYDRAULIC	R	RESISTANCE

EXAMPLE

CURRENT TO PNEUMATIC TRANSDUCER (BACK OF PANEL, IN A FLOW LOOP)

ACCESSORY DEVICES

A	ALARM
C	CONTROLLER
I	INDICATOR
R	RECORDER
S	SWITCH
T	TRANSMITTER
X	UNCLASSIFIED

EXAMPLE

TRANSMITTER AS AN ACCESSORY TO A FLOW ELEMENT

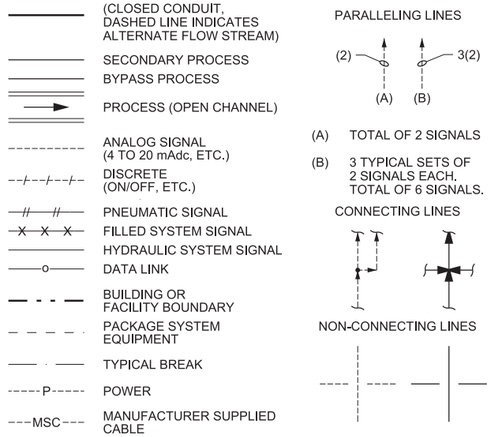
SPECIAL CASES

ON AND OFF EVENT LIGHTS

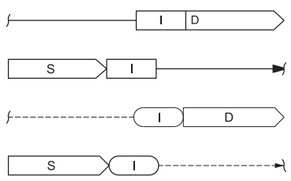
ON-OFF HAND SWITCH, MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).

STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

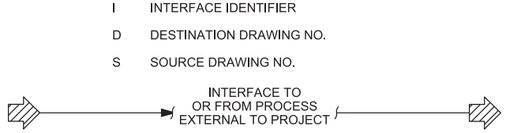
LINE LEGEND



INTERFACE SYMBOLS



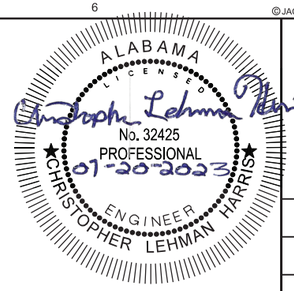
- I INTERFACE IDENTIFIER
- D DESTINATION DRAWING NO.
- S SOURCE DRAWING NO.



SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

D-W-X-Y

D	ARV	AIR RELEASE VALVE
	AVRV	AIR AND VACUUM RELEASE VALVE
	E	EJECTOR
	EXT	EXPANSION TANK
	G	GATE
	M	MECHANICAL EQUIPMENT
	P	PUMP
	SEP	AIR SEPARATOR
	T	TANK
W		UNIT PROCESS NUMBER
X		LOOP NUMBER
Y		UNIT NUMBER



ABBREVIATIONS & LETTER SYMBOLS

AC	ALTERNATING CURRENT
AM	AUTO-MANUAL
CAM	COMPUTER-AUTO-MANUAL
CCS	CENTRAL CONTROL SYSTEM
CL_2 etc.	CHLORINE (TYPICAL; USE STANDARD CHEMICAL ELEMENT ABBREVIATIONS)
CM	COMPUTER-MANUAL
COD	CHEMICAL OXYGEN DEMAND
CP-X	CONTROL PANEL NO. X
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DCU	DISTRIBUTED CONTROL UNIT
DO	DISSOLVED OXYGEN
FCL_2	FREE CHLORINE RESIDUAL
FOS	FAST-OFF-SLOW
FOSA	FAST-OFF-SLOW-AUTO
FOSR	FAST-OFF-SLOW-REMOTE
FP-W-X	FIELD PANEL NO. WX (W=UNIT PROCESS NUMBER X=PANEL NUMBER)
FR	FORWARD-REVERSE
FVR	FULL VOLTAGE REVERSING STARTER
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
ISB	INTRINSICALLY SAFE BARRIER
ISR	INTRINSICALLY SAFE RELAY
LEL	LOWER EXPLOSIVE LIMIT
LOS	LOCKOUT STOP
LR	LOCAL-REMOTE
MA	MANUAL-AUTO
MC	MODULATE-CLOSE
MCC-X	MOTOR CONTROL CENTER NO. X
MSC	MANUFACTURER SUPPLIED CABLE
OC	OPEN-CLOSE(D)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OIU	OPERATOR INTERFACE UNIT
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
ORP	OXIDATION REDUCTION POTENTIAL
OSC	OPEN-STOP-CLOSE
pH	HYDROGEN ION CONCENTRATION
PLC	PROGRAMMABLE LOGIC CONTROLLER
RIO	REMOTE I/O UNIT
RM-X	REMOTE MULTIPLEXING MODULE NO. X
RTU-X	REMOTE TELEMETRY UNIT NO. X
SF	SLOWER-FASTER
SS	START-STOP
SS1	SURGE SUPPRESSOR TYPE 1, 120VAC
SSC	SUPERVISORY SET POINT CONTROL
TCL_2	TOTAL CHLORINE RESIDUAL
TOC	TOTAL ORGANIC CARBON
TOD	TOTAL OXYGEN DEMAND
TURB	TURBIDITY
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION
△	DIFFERENCE
Σ	SUM
×	MULTIPLY
÷	DIVIDE
F(X)	CHARACTERIZED
X^n	RAISED TO THE Nth POWER
√‾	SQUARE ROOT
AVG	AVERAGE
1:1	REPEAT OR BOOST
>	SELECT HIGHEST SIGNAL
<	SELECT LOWEST SIGNAL
}	BIAS
%	GAIN OR ATTENUATE

GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (∗) ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (∗∗) ARE TO BE PROVIDED UNDER DIVISION 26, ELECTRICAL.
3. COMPONENTS AND PANELS SHOWN WITH A SINGLE DIAMOND (◆) ARE TO PROVIDED BY PICS UNDER DIVISION 40, INSTRUMENTATION AND CONTROL.
4. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THE PROJECT.

NO.	DATE	DSGN	DR	CHK	BY	APVD
		C HARRIS	A PASTRANA	G GRAY	C HARRIS	APVD

REVISION

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL
INSTRUMENTATION AND CONTROL LEGEND 1

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-005
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VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- V VEE-BALL
- PLUG
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- BACKFLOW PREVENTER
- ROTARY
- TELESCOPE
- S SAMPLE
- MUD
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- PRESSURE REGULATION (CLAY-TYPE)
- MULTI-PORT VALVE (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE

GATE SYMBOLS

- SLUICE
- BUTTERFLY
- FABRICATED SLIDE
- FLAP
- STOP LOG
- SHEAR

ACTUATOR SYMBOLS

- PNEUMATIC DIAPHRAGM SPRING-OPPOSED, SINGLE OR DOUBLE ACTING
- PNEUMATIC CYLINDER SINGLE OR DOUBLE ACTING ACTUATED BY ONE INPUT
- M ELECTRIC MOTOR
- S SOLENOID
- VALVE POSITIONER
- H HYDRAULIC
- DIAPHRAGM, DIFFERENTIAL PRESSURE
- E/H ELECTROHYDRAULIC
- MANUAL

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL, OR HYDRAULIC)

XX: FO FAIL OPEN
FC FAIL CLOSED
FLP FAIL TO LAST POSITION

PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- WEIR
- ORFICE PLATE
- FLOW TUBE
- PITOT-STATIC
- VORTEX METER
- ULTRASONIC FLOWMETER
- M ELECTROMAGNETIC FLOWMETER
- PROPELLER OR TURBINE METER
- THERMAL FLOWMETER
- LEVEL (BUBBLER TUBE)
- LS LEVEL (FLOAT)
- FI ROTAMETER
- DE DENSITY METER
- XX GENERIC
- LE LEVEL

MISCELLANEOUS SYMBOLS

- V VENT TO ATMOSPHERE
- AIR GAP
- T DRIP TRAP
- PIG INSERT POINT
- PIG CATCH POINT
- A SELF CONTAINED AIR SUPPLY
- AP AIR PURGE SET
- F FLUSHING CONNECTION
- S SEAL WATER SET
- WP WATER PURGE SET
- FLEXIBLE CONNECTION
- AERATOR
- DIAPHRAGM SEAL
- ANNULAR DIAPHRAGM SEAL
- COMPOSITE SAMPLER
- FLAME TRAP
- CALIBRATION COLUMN
- S INLINE SILENCER
- BLIND FLANGE
- PIPE CAP
- STRAINER
- BASKET STRAINER
- FILTER
- PULSATION DAMPENER
- EXPANSION CHAMBER

FFLCPLLLX
- PANEL CONTINUED ON SAME OR OTHER DRAWING
- PANEL OUTLINE
- PANEL NAME

- 120V — 120 VOLT, 60 HZ POWER
- 480V — 480 VOLT, 60 HZ POWER
- XX AIR SET XX = SUPPLY PRESSURE IN PSIG.
- PLUG
- RECEPTACLE
- RUPTURE DISK (VACUUM)
- RUPTURE DISK (PRESSURE)
- TV TV MONITOR
- TV TV CAMERA
- A, B → AND → C LOGIC ELEMENT: IF A AND NOT B THEN C
- A, B → OR → C LOGIC ELEMENT: IF A OR B THEN C
- RADIO ANTENNA
- OR I INTERLOCK, SEE CONTROL DIAGRAMS
- VOICE COMMUNICATION POINT
- SKIMMING MECHANISM
- SCREW CONVEYOR
- MIXER
- ELECTRIC MOTOR
- M DRUM SCREEN

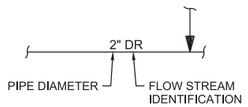
PUMP AND COMPRESSOR SYMBOLS

- CENTRIFUGAL PUMP (DRY PIT) XX
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP XX
- RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT) XX
- DIAPHRAGM PUMP XX
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT) XX
- PROGESSING CAVITY PUMP XX
- COMPRESSOR (CENTRIFUGAL) XX
- COMPRESSOR (PISTON) XX
- BLOWER OR FAN (CENTRIFUGAL) XX
- EJECTOR
- PISTON PUMP XX
- SUBMERSIBLE SUMP PUMP XX
- ROTARY PUMP
- VACUUM PUMP
- SCREW PUMP

XX: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

LINE SIZE AND MATERIAL IDENTIFICATION

(FOR REFERENCE ONLY. SEE SITE AND MECHANICAL DRAWINGS)



CISP	CAST IRON SOIL PIPE
CLDI	CEMENT LINED DUCTILE IRON
CLSTL	CEMENT LINED STEEL
CU	COPPER
FRP	FIBERGLASS REINFORCED PLASTIC
PVC	POLYVINYL CHLORIDE
SST	STAINLESS STEEL
STL	STEEL

FLOW STREAM IDENTIFICATION

DG	DIGESTER GAS
D (or) DR	DRAIN
GR	GRIT SLURRY
OF	OVERFLOW
PDD	PLANT DRAIN DISCHARGE
RS	RAW SEWAGE
SA	SAMPLE
SCR	SCREENINGS
SRS	SCREENED RAW SEWAGE
W3	NO. 3 WATER

ALABAMA LICENSED
Christopher Lehman Harris
No. 32425
PROFESSIONAL
07-20-2023
CHRISTOPHER LEHMAN HARRIS
ENGINEER

NO.	DATE	REVISION	BY	APVD
DSGN	C HARRIS			C HARRIS
DR	A PASTRANA		CHK	G GRAY
			APVD	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
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GENERAL
INSTRUMENTATION AND CONTROL LEGEND 2

BID DOCUMENTS

VERIFY SCALE
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DATE	JULY 2023
PROJ	D3571200
DWG	01-G-006
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ONE LINE DIAGRAMS-1

SYMBOL	DESCRIPTION
	DRAWOUT AIR CIRCUIT BREAKER, LOW VOLTAGE
400	CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE, UNO
AS/AF OR AT/AF	CIRCUIT BREAKER, STATIC TRIP UNIT, SENSOR AMP TRIP AND FRAME RATINGS SHOWN, 3 POLE, UNO
100/M	CIRCUIT BREAKER, MAGNETIC TRIP ONLY, FRAME SIZE SHOWN, 3 POLE, UNO
400 400	CIRCUIT BREAKER WITH CURRENT LIMITING FUSES, TRIP AND FUSE RATING INDICATED, 3 POLE, UNO
400 225	FUSED SWITCH, SWITCH AND FUSE CURRENT RATING INDICATED, 3 POLE, UNO
100	SWITCH - CURRENT RATING INDICATED, 3 POLE, UNO
60 (3)	FUSE, RATING AND QUANTITY INDICATED
1	MAGNETIC STARTER WITH OVERLOAD, NEMA SIZE INDICATED
AFD RVSS, AFD, or DC	ELECTRONIC STARTER/SPEED CONTROL SS = AC SOLID STATE SOFT STARTER AFD = AC ADJUSTABLE FREQUENCY DRIVE DC = DC ADJUSTABLE SPEED DRIVE
	CABLE OR BUS CONNECTION POINT
K	KEY INTERLOCK
	SURGE ARRESTER (GAP TYPE)
10	CAPACITOR - KVAR INDICATED, 3 PHASE
3	MOTOR, SQUIRREL CAGE INDUCTION - HORSEPOWER INDICATED
VS V 0-600V	ANALOG METER WITH SWITCH - SCALE RANGE SHOWN V = VOLTAGE KW = KILOWATTS A = AMPERAGE KVAR = KILOVARS PF = POWER FACTOR
DPM	DIGITAL POWER METER (MULTIFUNCTION)
	GROUND
120/240V 15 KVA 1 PH	TRANSFORMER, SECONDARY VOLTAGES, PHASE AND RATING INDICATED AS APPLICABLE
(3)	POTENTIAL TRANSFORMER, QUANTITY INDICATED (3)
100:5 (3)	CURRENT TRANSFORMER, RATIO(100:5) AND QUANTITY INDICATED (3)
	CONNECTION POINT TO EQUIPMENT SPECIFIED IN OTHER DIVISIONS. RACEWAY, CONDUCTOR AND CONNECTION IN THIS DIVISION

CONTROL DIAGRAMS-1

SYMBOL	DESCRIPTION
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY OPEN
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY CLOSED
	PUSH BUTTON SWITCH, MAINTAINED CONTACTS WITH MECHANICAL INTERLOCK
	3 POSITION SELECTOR SWITCH MAINTAINED CONTACT
HAND OFF REMOTE	SELECTOR SWITCH - MAINTAINED CONTACT - CHART IDENTIFIES OPERATION:

	POSITION		
CKT	HAND	OFF	REMOTE
1	X	O	O
2	O	O	X

SYMBOL	DESCRIPTION
	TOGGLE SWITCH, ON-OFF TYPE
ON OFF	SELECTOR SWITCH, ON-OFF TYPE
	MUSHROOM HEAD SWITCH
A	INDICATING LIGHT, PUSH-TO-TEST, LETTER INDICATES COLOR
A	INDICATING LIGHT - LETTER INDICATES COLOR A - AMBER G - GREEN S - STROBE B - BLUE R - RED C - CLEAR W - WHITE
ETM	ELAPSED TIME METER
M	MOTOR STARTER CONTACTOR COIL
CRX	CONTROL RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
TDR X	TIME DELAY RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
SV X	SOLENOID VALVE, X INDICATES NUMERICAL ORDER IN CIRCUIT
	CONTACT - NORMALLY OPEN
	CONTACT - NORMALLY CLOSED
	REMOTE DEVICE
	TIME DELAY RELAY CONTACT, NORMALLY OPEN, CLOSES WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, NORMALLY CLOSED, OPENS WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, CLOSES WHEN ENERGIZED, OPENS WHEN TIMED OUT
	TIME DELAY RELAY CONTACT, OPENS WHEN ENERGIZED, CLOSES WHEN RE-ENERGIZED AND TIMED OUT
	MOTOR SPACE HEATER
	TERMINAL BLOCK, REMOTE
	TERMINAL BLOCK, INTERNAL
	FUSED TERMINAL BLOCK
SS	SURGE ARRESTOR, AC OR DC AS INDICATED BY SIGNAL TYPE
	FUSE, RATING INDICATED
CPT 120V	TRANSFORMER, CONTROL POWER

POWER SYSTEM PLAN-1

SYMBOL	DESCRIPTION
	CONNECTION POINT TO EQUIPMENT SPECIFIED. RACEWAY, CONDUCTOR,TERMINATION AND CONNECTION IN THIS DIVISION.
MCC-A	MAJOR ELECTRICAL COMPONENT OR DEVICE - NAME OR IDENTIFYING SYMBOL AS SHOWN.
	PANELBOARD - SURFACE MOUNTED
LPA	PANELBOARD LETTER LP - LIGHTING PANEL DP - DISTRIBUTION PANEL
	PANELBOARD - FLUSH MOUNTED
	TERMINAL JUNCTION BOX
M	MOTOR, SQUIRREL CAGE INDUCTION
G	GENERATOR, VOLTAGE AND SIZE AS INDICATED.
LPA-2	HOME RUN - DESTINATION SHOWN
— or —/G	EXPOSED CONDUIT AND CONDUCTORS*
– – or –/G	CONCEALED CONDUIT AND CONDUCTORS*

NOTE:
ALL UNMARKED CONDUIT RUNS CONSIST OF TWO NO. 12, ONE NO. 12 GROUND CONDUCTORS IN 3/4" CONDUIT. RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 CONDUCTORS. CROSSHATCH WITH SUBSCRIPT "G" INDICATES GREEN GROUND WIRE.

SYMBOL	DESCRIPTION
/G	CROSSHATCHES WITH BAR INDICATE NO.10 CONDUCTOR. SIZE CONDUIT ACCORDING TO SPECIFICATIONS AND APPLICABLE CODE.
[A1]	CONDUCTOR AND RACEWAY CALLOUT - FOR CONDUIT AND CONDUCTORS, SEE LEGEND.
	CONDUIT DOWN
	CONDUIT UP
	CONDUIT, STUBBED AND CAPPED AS SHOWN
	CONDUIT TERMINATION AT CABLE TRAY
EX	EXISTING CONDUIT/ DUCK BANK
CT	CABLE TRAY - SEE SPECIFICATIONS
BD	BUS DUCT - SEE SPECIFICATIONS
CE	CONCRETE ENCASED CONDUIT
DB	DIRECT BURIED CONDUIT
FO	FIBER OPTIC CONDUIT
XXXX	CONCRETE ENCASED DUCT BANK WHERE XXXX IS THE DUCT BANK NAME. SEE CIRCUIT AND RACEWAY CODING DEFINITION
	CONCEALED CONDUIT ROUTING AREA
	CONDUIT ROUTING AREA
	CABLE TRAY
J or HH	GENERAL CONTROL OR WIRING DEVICE. LETTER SYMBOLS OR ABBREVIATIONS INDICATE TYPE OF DEVICE.
CS	CONTROL STATION, SEE CONTROL DIAGRAMS FOR CONTROL DEVICE(S) REQUIRED.
30/3/4x	NONFUSED DISCONNECT SWITCH, SIZE INDICATED, 3 POLE, NEMA ENCLOSURE
60/40/3/4x F	FUSED DISCONNECT SWITCH, SIZE INDICATED (60/40, 60 = SWITCH RATING: 40 = FUSE RATING) 3 POLE, NEMA ENCLOSURE
2	COMBINATION CIRCUIT BREAKER AND INDICATED) MAGNETIC STARTER, NEMA SIZE INDICATED

David C. Nicholson
CN=David C. Nicholson, OU=Engineering, O=Jacobs Engineering Group Inc., L=Dallas, S=Texas, C=US
2023.07.19 17:07:21-04'00'

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

POWER SYSTEM PLAN-2

SYMBOL	DESCRIPTION
100/40 B	BREAKER, SEPARATELY MOUNTED, SIZE INDICATED (100/40, 100 = FRAME SIZE; 40 = TRIP RATING) 3 POLE
2	CONTACTOR, MAGNETIC, NEMA SIZE INDICATED
L 30	LIGHTING CONTACTOR, SIZE INDICATED
2	STARTER, MAGNETIC NEMA SIZE INDICATED
	CONVENIENCE RECEPTACLE - DUPLEX UNLESS NOTED OTHERWISE WP - WEATHERPROOF C - CLOCK HANGER TL - TWIST LOCK CRE - CORROSION RESISTANT SUBSCRIPT NUMBER AT RECEPTACLE INDICATES CIRCUIT
	240V RECEPTACLE
	CONVENIENCE RECEPTACLE - QUADRUPLEX
	MULTI OUTLET ASSEMBLY
	DUPLEX CONVENIENCE RECEPTACLE - FLUSH IN FLOOR
	CONVENIENCE RECEPTACLE, PEDESTAL, DUPLEX SINGLE FACE UNLESS INDICATED OTHERWISE
L20R 20	RECEPTACLE, SPECIAL PURPOSE - NEMA CONFIGURATION AND AMPERAGE INDICATED
T	THERMOSTAT
	METERING FACILITY
EUH	ELECTRIC UNIT HEATER
AC	ELECTRIC AIR CONDITIONER (SELF CONTAINED UNIT)

LIGHTING SYSTEM PLAN

SYMBOL	DESCRIPTION
1 or 1	LUMINAIRE, SEE SCHEDULE
1	LUMINAIRE, SEE SCHEDULE
1	LUMINAIRE WITH INTERNAL BATTERY BACKUP, SEE SCHEDULE
4 or 4	STANCHION MOUNTED LUMINAIRE, SEE SCHEDULE
5 or 5	WALL MOUNTED LUMINAIRE, SEE SCHEDULE
1	FLOOD LIGHTS - AIM IN THE DIRECTION SHOWN
	STANDBY LIGHTING UNIT, FLUSH MOUNTED, SEE SCHEDULE
	STANDBY LIGHTING UNIT, SURFACE MOUNTED, SEE SCHEDULE
XX or	EXIT LIGHTS - FILLED SECTION INDICATES LIGHTED FACE, ARROW INDICATES EGRESS DIRECTIONAL INDICATORS, SEE DRAWINGS XX = FIXTURE NUMBER, SEE SCHEDULE
Sa or a 1 -25	SMALL LETTER SUBSCRIPT AT SWITCH AND LUMINAIRE INDICATES SWITCHING. SUBSCRIPT NUMBER AT LUMINAIRE INDICATES LUMINAIRE TYPE. DASH NUMBER INDICATES CIRCUIT.
S WALL SWITCH:	2- DOUBLE POLE P- PILOT LIGHT 3- THREE WAY K- KEY OPERATED 4- FOUR WAY D- DIMMER WP- WEATHERPROOF CRE- CORROSION RESISTANT EX- EXPLOSIONPROOF L- MOMENTARY 3-WAY M- MOTOR RATED MS- MANUAL STARTER WITH OVERLOADS OS OCCUPANCY SENSOR
OS	OCCUPANCY SENSOR, SEE SCHEDULE
LC	LIGHTING CONTROLLER

NO.	DATE	REVISION	DR	CHK
DSGN	T TWIST	V MCCORVEY	D NICHOLSON	D NICHOLSON
			BY	APVD
			D NICHOLSON	APVD

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL
ELECTRICAL LEGEND 1

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-007
SHEET	07 of 32

SECURITY SYSTEM PLAN

SYMBOL	DESCRIPTION
PCR	PROXIMITY CARD READER
BMS	BALANCED MAGNETIC SWITCH
CS	CONTROL STATION
	FIXED VIDEO CAMERA
PIR	INFRARED PROXIMITY READER
EDS	ELECTRIC DOOR STRIKE
	PAN TILT ZOOM VIDEO CAMERA
RDS	ROLLUP DOOR SWITCH
DS	DOOR SWITCH

GROUND SYSTEM PLAN

SYMBOL	DESCRIPTION
⊗	GROUND ROD
⊗	GROUND ROD IN TEST WELL
— — G — —	GROUNDING CONDUCTOR, SIZE AS INDICATED
Ⓒ	ATTACH GROUNDING CONDUCTOR TO EQUIPMENT FRAME OR STRUCTURAL STEEL WITH UL LISTED CLAMP. REFER TO SPECIFICATIONS
Ⓡ	EXOTHERMIC WELD GROUNDING CONDUCTOR TO STEEL REINFORCEMENT WITH MINIMUM 2" COVER

CHEMICAL AND FIRE ALARM PLAN

SYMBOL	DESCRIPTION
CA	CHEMICAL ALARM
EE	CHEMICAL EXHAUST EMERGENCY OFF
CACP	CHEMICAL ALARM CONTROL PANEL
F	FIRE ALARM STATION, MANUAL
F	FIRE ALARM HORN/STROBE LIGHT
SP	FIRE ALARM STATION, AUTOMATIC SMOKE DETECTOR
FH	FIRE ALARM, AUTOMATIC HEAT DETECTOR
D	AIR DUCT DETECTOR

ONE LINE PROTECTION RELAYING AND ELEMENTARY DIAGRAMS - 1

SYMBOL	DESCRIPTION
51 or 52	DEVICE FUNCTION NUMBER INDICATED, SEE DEVICE TABLE
CS T	CONTROL SWITCH TRIP
CS C	CONTROL SWITCH CLOSE
43/CS	43-DEVICE FUNCTION NUMBER, SEE DEVICE TABLE
VS	VOLTMETER SWITCH
AS	AMMETER SWITCH
A	INDICATING LAMP-SWITCHBOARD TYPE INDICATING LAMP LENS COLORS INDICATED AS FOLLOWS: A - AMBER B - BLUE W - WHITE R - RED G - GREEN
V	VOLTMETER
A	AMMETER
W	WATTMETER
F	FREQUENCY METER
PF	POWER FACTOR METER
W	WATT-HOUR METER
ETM	ELAPSED TIME METER

ONE LINE PROTECTION RELAYING AND ELEMENTARY DIAGRAMS - 1

SYMBOL	DESCRIPTION
RPM	SPEEDOMETER
W XD	WATTS TRANSDUCER
PF XD	POWER FACTOR TRANSDUCER
TD	TIME DELAY
4	RELAY COIL, DEVICE FUNCTION NUMBER PER ANSI 37.2 - AMERICAN STANDARD MANUAL AND AUTOMATIC STATION CONTROL, SUPERVISORY AND ASSOCIATED TELEMETRY EQUIPMENT
7 8	NORMALLY OPEN CONTACT
3 4	NORMALLY CLOSED CONTACT
	REMOTE DEVICE
	TEST SWITCH CURRENT ELEMENT
	TEST SWITCH POTENTIAL ELEMENT
	NEUTRAL CONNECTION
	DIODE
	INSTRUMENTATION CABLE, SHIELDED
NGR	NEUTRAL GROUNDING RESISTOR
PST	PHASE SHIFTING TRANSFORMER
4	COMBINATION TELEPHONE/DATA RECEPTACLE, WALL MOUNTED, NUMBER OF PORTS INDICATED. PROVIDE 1"C, FROM RECEPTACLE TO TELEPHONE TERMINAL CABNET, UNLESS NOTED OTHERWISE

CONTROL CABLE CIRCUIT CALLOUTS	
[CC5]	[3/4"C,1-5C TYPE 1]
[CC7]	[3/4"C,1-7C TYPE 1]
[CC9]	[1"C,1-9C TYPE 1]
[CC12]	[1"C,1-12C TYPE 1]
[CC19]	[1 1/2 ", 1-19C TYPE 1]
[CC25]	[1 1/2"C,1-25C TYPE 1]
[CC37]	[2"C,1-37C TYPE 1]
[CCC1]	[1-7C #12 TYPE 1]
[D1]	[3/4"C, BELDEN #3084]
[D2]	[3/4"C, ALLEN-BRADELY 889-C5AC]
[D3]	[3/4"C, BELDEN #1583A]
[D4]	[3/4"C, BELDEN #1189A]
[D5]	[3/4"C, ALPHA #58136]
[CAT]	[1"C, CAT 6 CABLE]
[CX]	[1"C, COAX]
[FMM]	[2"C, MILTI MODE FIBER OPTIC CABLE]
[PH]	[1"C, PHONE CABLE]
[M]	[2"C, MODBUS SERIAL]

AFD POWER CABLE CALLOUTS	
[20PV3]	[1"C,1(3C#12,1#12G) TYPE 8]
[30PV3]	[1 1/2"C,1(3C#10,1#10G) TYPE 8]
[40PV3]	[1 1/2"C,1(3C#8,1#8G) TYPE 8]
[60PV3]	[2"C,1(3C#6,1#6G) TYPE 8]
[80PV3]	[2"C,1(3C#4,1#4G) TYPE 8]
[100PV3]	[2 1/2"C,1(3C#2,1#2G) TYPE 8]
[150PV3]	[2 1/2"C,1(3C#1/0,3#10G) TYPE 9]
[175PV3]	[2 1/2"C,1(3C#2/0,3#8G) TYPE 9]
[200PV3]	[3"C,1(3C#4/0,3#8G) TYPE 9]
[250PV3]	[3"C,1(3C#250,3#8G) TYPE 9]
[300PV3]	[3 1/2"C,1(3C#350,3#8G) TYPE 9]
[350PV3]	[4"C,1(3C#500KCM,3#8G) TYPE 9]
[400PV3]	[2 EACH [2"C,1 (3C#4/0, 3#8G) TYPE 9]
[500PV3]	[2 EACH [3"C, 1(3C#250,1#8G) TYPE 9]

POWER CIRCUIT CALLOUT SCHEDULE

EQUIPMENT GROUNDS NEC 250 Table 122		100% GROUNDS NEC 250-122(A)		SERVICE NEUTRALS NEC 250 Table 66	
2 Wire + Ground					
[20E2]	3/4"C-2#12,#12G	[20M2]	3/4"C-2#12,#12G	NA	NA
[30E2]	3/4"C-2#10,#10G	[30M2]	3/4"C-2#10,#10G	NA	NA
[40E2]	3/4"C-2#8,#10G	[40M2]	3/4"C-2#8,#8G	[40S2]	3/4"C-2#8,#8N
[50E2]	3/4"C-2#8,#10G	[50M2]	3/4"C-2#8,#8G	[50S2]	3/4"C-2#8,#8N
[60E2]	1"C-2#6,#10G	[60M2]	1"C-2#6,#6G	[60S2]	3/4"C-2#6,#8N
[70E2]	1"C-2#4,#8G	[70M2]	1"C-2#4,#4G	[70S2]	3/4"C-2#4,#8N
[80E2]	1"C-2#4,#8G	[80M2]	1"C-2#4,#4G	[80S2]	3/4"C-2#4,#8N
[90E2]	1"C-2#3,#8G	[90M2]	1"C-2#3,#3G	[90S2]	1"C-2#3,#8N
[100E2]	1"C-2#3,#8G	[100M2]	1"C-2#3,#3G	[100S2]	1"C-2#3,#8N
[110E2]	1"C-2#2,#6G	[110M2]	1"C-2#2,#2G	[110S2]	1"C-2#2,#8N
[125E2]	1-1/4"C-2#1,#6G	[125M2]	1-1/4"C-2#1,#1G	[125S2]	1-1/4"C-2#1,#6N
[150E2]	1-1/4"C-2#1/0,#6G	[150M2]	1-1/4"C-2#1/0,#1/0G	[150S2]	1-1/4"C-2#1/0,#6N
[200E2]	1-1/2"C-2#3/0,#6G	[200M2]	1-1/2"C-2#3/0,#3/0G	[200S2]	1-1/4"C-2#3/0,#4N
[225E2]	2"C-2#4/0,#4G	[225M2]	2"C-2#4/0,#4/0G	[225S2]	1-1/2"-2#4/0,#2N
[400E2]	3"C-2#500,#3G	[400M2]	3"C-2#500,#500G	[400S2]	3"-2#500,#1/0N
3 Wire + Ground					
[20E3]	3/4"C-3#12,#12G	[20M3]	3/4"C-3#12,#12G	NA	NA
[30E3]	3/4"C-3#10,#10G	[30M3]	3/4"C-3#10,#10G	NA	NA
[40E3]	3/4"C-3#8,#10G	[40M3]	3/4"C-3#8,#8G	[40S3]	3/4"C-3#8,#8N
[50E3]	3/4"C-3#8,#10G	[50M3]	3/4"C-3#8,#8G	[50S3]	3/4"C-3#8,#8N
[60E3]	3/4"C-3#6,#10G	[60M3]	3/4"C-3#6,#6G	[60S3]	3/4"C-3#6,#8N
[70E3]	1"C-3#4,#8G	[70M3]	1"C-3#4,#4G	[70S3]	1"C-3#4,#8N
[80E3]	1"C-3#4,#8G	[80M3]	1"C-3#4,#4G	[80S3]	1"C-3#4,#8N
[90E3]	1-1/4"C-3#3,#8G	[90M3]	1-1/4"C-3#3,#3G	[90S3]	1"C-3#3,#8N
[100E3]	1-1/4"C-3#3,#8G	[100M3]	1-1/4"C-3#3,#3G	[100S3]	1"C-3#3,#8N
[110E3]	1-1/2"C-3#2,#6G	[110M3]	1-1/2"C-3#2,#2G	[110S3]	1"C-3#2,#8N
[125E3]	1-1/2"C-3#1,#6G	[125M3]	1-1/2"C-3#1,#1G	[125S3]	1-1/2"C-3#1,#6N
[150E3]	1-1/2"C-3#1/0,#6G	[150M3]	1-1/2"C-3#1/0,#1/0G	[150S3]	1-1/4"C-3#1/0,#6N
[200E3]	2"C-3#3/0,#6G	[200M3]	2"C-3#3/0,#3/0G	[200S3]	1-1/2"C-3#3/0,#4N
[225E3]	2"C-3#4/0,#4G	[225M3]	2"C-3#4/0,#4/0G	[225S3]	2"C-3#4/0,#2N
[250E3]	2-1/2"C-3#300,#4G	[250M3]	2-1/2"C-3#300,#300G	[250S3]	2-1/2"C-3#300,#2N
[300E3]	3"C-3#350,#4G	[300M3]	3"C-3#350,#350G	[300S3]	2-1/2"C-3#350,#2N
[350E3]	3"C-3#500,#3G	[350M3]	3"C-3#500,#500G	[350S3]	3"C-3#500,#1/0N
[400E3]	3"C-3#500,#3G	[400M3]	3"C-3#500,#500G	[400S3]	3"C-3#500,#1/0N
[500E3]	(2)2-1/2"C-3#250,#2G	[500M3]	(2)2-1/2"C-3#250,#250G	[500S3]	(2)2-1/2"C-3#250,#1/0N
[600E3]	(2)3"C-3#350,#1G	[600M3]	(2)3"C-3#350,#350G	[600S3]	(2)3"C-3#350,#2/0N
[700E3]	(2)3"C-3#500,#1/0G	[700M3]	(2)3"C-3#500,#500G	[700S3]	(2)3"C-3#500,#2/0N
[800E3]	(2)3"C-3#500,#1/0G	[800M3]	(2)3"C-3#500,#500G	[800S3]	(2)3"C-3#500,#2/0N
[1000E3]	(3)3"C-3#350,#2/0G	[1000M3]	(3)3"C-3#500,#500G	[1000S3]	(3)3"C-3#500,#3/0N
[1200E3]	(3)3-1/2"C-3#600,#3/0G	[1200M3]	(3)4"C-3#600,#600G	[1200S3]	(3)3-1/2"C-3#600,#3/0N
[1600E3]	(4)3-1/2"C-3#600,#4/0G	[1600M3]	(4)3-1/2"C-3#600,#600G	[1600S3]	(4)4"C-3#600,#3/0N
[2000E3]	(5)3-1/2"C-3#600,#250G	[2000M3]	(5)3-1/2"C-3#600,#600G	[2000S3]	(5)3-1/2"C-3#600,#3/0N
[2500E3]	(6)3-1/2"C-3#600,#350G	[2500M3]	(6)3-1/2"C-3#600,#600G	[2500S3]	(6)3-1/2"C-3#600,#3/0N
[3000E3]	(8)3-1/2"C-3#600,#400G	[3000M3]	(8)3-1/2"C-3#600,#600G	[3000S3]	(8)3-1/2"C-3#600,#3/0N
[4000E3]	(10)3-1/2"C-3#600,#500G	[4000M3]	(10)3-1/2"C-3#600,#600G	[4000S3]	(10)3-1/2"C-3#600,#3/0N
4 Wire + Ground				**MULTI-WIRE 20 AMP**	
[20E4]	3/4"C-4#12,#12G	[20M4]	3/4"C-4#12,#12G	[20E5]	3/4"C-5#12,1#12G
[30E4]	3/4"C-4#10,#10G	[30M4]	3/4"C-4#10,#10G	[20E6]	3/4"C-6#12,1#12G
[40E4]	3/4"C-4#8,#10G	[40M4]	3/4"C-4#8,#8G	[20E7]	3/4"C-7#12,1#12G
[50E4]	3/4"C-4#8,#10G	[50M4]	3/4"C-4#8,#8G	[20E8]	3/4"C-8#12,1#12G
[60E4]	1"C-4#6,#8G	[60M4]	1"C-4#6,#6G	[20E9]	3/4"C-9#12,1#12G
[70E4]	1-1/4"C-4#4,#8G	[70M4]	1-1/4"C-4#4,#4G	[20E10]	1"C-10#10,1#10G
[80E4]	1-1/4"C-4#4,#8G	[80M4]	1-1/4"C-4#4,#4G	[20E11]	1"C-11#10,1#10G
[90E4]	1-1/4"C-4#3,#8G	[90M4]	1-1/4"C-4#3,#3G	[20E12]	1"C-12#10,1#10G
[100E4]	1-1/4"C-4#3,#8G	[100M4]	1-1/4"C-4#3,#3G	[20E13]	1"C-13#10,1#10G
[110S4]	1-1/2"C-4#2,#6G	[110M3]	1-1/2"C-4#2,#2G	[20E14]	1"C-14#10,1#10G
[125E4]	1-1/2"C-4#1,#6G	[125M4]	1-1/2"C-4#1,#1G	[20E15]	1"C-15#10,1#10G
[150E4]	2"C-4#1/0,#6G	[150M4]	2"C-4#1/0,#1/0G	[20E16]	1-1/4"C-16#10,1#10G
[200E4]	2"C-4#3/0,#6G	[200M4]	2"C-4#3/0,#3/0G	[20E17]	1-1/4"C-17#10,1#10G
[225E4]	2-1/2"C-4#4/0,#4G	[225M4]	2-1/2"C-4#4/0,#4/0G	[20E18]	1-1/4"C-18#10,1#10G
[250E4]	3"C-4#300,#4G	[250M4]	3"C-4#300,#300G	[20E19]	1-1/4"C-19#10,1#10G
[300E4]	3"C-4#350,#2G	[300M4]	3"C-4#350,#350G	[20E20]	1-1/4"C-20#10,1#10G
[350E4]	3-1/2"C-4#500,#3G	[350M4]	3-1/2"C-4#500,#500G		
[400E4]	3-1/2"C-4#500,#3G	[400M4]	3-1/2"C-4#500,#500G		
[500E4]	(2)3-1/2"C-4#250,#2G	[500M4]	(2)3-1/2"C-4#250,#250G		
[600E4]	(2)3"C-4#350,#1G	[600M4]	(2)3"C-4#350,#350G		
[700E4]	(2)3-1/2"C-4#500,#1/0G	[700M4]	(2)3-1/2"C-4#500,#500G		
[800E4]	(2)3-1/2"C-4#500,#1/0G	[800M4]	(2)3-1/2"C-4#500,#500G		
[1000E4]	(3)3"C-4#350,#2/0G	[1000M4]	(3)3"C-4#350,#350G		
[1200E4]	(3)4"C-4#600,#3/0G	[1200M4]	(3)4"C-4#600,#600G		
[1600E4]	(4)4"C-4#600,#4/0G	[1600M4]	(4)4"C-4#600,#600G		
[2000E4]	(5)4"C-4#600,#250G	[2000M4]	4"C-4#600,#600G		
[2500E4]	(6)4"C-4#600,#350G	[2500M4]	4"C-4#600,#600G		
[3000E4]	(8)4"C-4#600,#400G	[3000M4]	4"C-4#600,#600G		
[4000E4]	(10)4"C-4#600,#500G	[4000M4]	4"C-4#600,#600G		

THE CONFIGURATIONS SHOWN IN THIS SECTION TITLED "MULTI-WIRE 20 AMP" SHALL NOT BE USED FOR RECEPTACLE CIRCUITS OR OTHER CORD-AND-PLUG-CONNECTED PORTABLE LOADS. NEC-240.4(B)

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No. 28944
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DAVID CARL NICHOLSON

CONTROL CIRCUIT CALLOUT SCHEDULE

DISCRETE CABLES	
[C1]	3/4"C, MSC
[C2]	3/4"C, 2#14, 1#14G
[C4]	3/4"C, 4#14, 1#14G
[C6]	3/4"C, 6#14, 1#14G
[C8]	3/4"C, 8#14, 1#14G
[C10]	3/4"C, 10#14, 1#14G
[C12]	3/4"C, 12#14, 1#14G
[C14]	3/4"C, 14#14, 1#14G
[C16]	3/4"C, 16#14, 1#14G
[C18]	3/4"C, 18#14, 1#14G
[C20]	1"C, 20#14, 1#14G
[C22]	1"C, 22#14, 1#14G
[C24]	1"C, 24#14, 1#14G
[C26]	1"C, 26#14, 1#14G
[C28]	1"C, 28#14, 1#14G
[C30]	1"C, 30#14, 1#14G
[C36]	1-1/2"C, 36#14, 1#14G
[C40]	2-1"C, 40#14, 1#14G
[C46]	1-1/2"C, 46#14, 1#14G
[C50]	1-1/2"C, 50#14, 1#14G
[C58]	1-1/2"C, 58#14, 1#14G
[C72]	1-1/2"C, 72#14, 1#14G
[C100]	2-1/2"C, 100#14, 1#14G
[C175]	4"C, 175#14, 1#14G

EMPTY CONDUIT CALLOUT	
[CE-1]	[3/4"C,WITH PULL STRING]
[CE-2]	[1"C,WITH PULL STRING]
[CE-3]	[1 1/4"C,WITH PULL STRING]
[CE-4]	[1 1/2"C,WITH PULL STRING]
[CE-5]	[2"C,WITH PULL STRING]
[CE-6]	[3"C,WITH PULL STRING]
[CE-7]	[4"C,WITH PULL STRING]
[CE-8]	[5"C,WITH PULL STRING]
[CE-9]	[6"C, WITH PULL STRING]

NO.	DATE	REVISION	DR	CHK	BY	APVD
DSGN		T TWIST	V MCCORVEY	D NICHOLSON	D NICHOLSON	D NICHOLSON

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

GENERAL
ELECTRICAL LEGEND 2

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	01-G-008
SHEET	08 of 32

GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL ELEVATIONS, LOCATIONS AND DIMENSIONS PRIOR TO COMMENCING WORK. ALL ELEVATIONS, LOCATIONS, AND DIMENSIONS SHOWN ARE APPROXIMATE AND BASED ON RECORD DRAWINGS.
2. CONTINUOUS OPERATION OF OWNER'S FACILITIES IS OF CRITICAL IMPORTANCE. CONTRACTOR TO ENSURE SCHEDULE AND CONDUCT ACTIVITIES TO ALLOW EXISTING FACILITIES TO OPERATE CONTINUOUSLY, UNTIL STARTUP OF NEW FACILITIES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SHORING, BRACING, CUTTING, FITTING, AND PATCHING REQUIRED TO COMPLETE THE WORK OR TO RESTORE WORK WHICH HAS BEEN CUT OR REMOVED FROM ITS ORIGINAL CONDITION THAT IS INDICATED TO REMAIN. ALL ADJACENT EXISTING WORK IN PLACE SHALL BE PROTECTED FROM DAMAGE DUE TO ANY NEW CONSTRUCTION AND/OR REPLACED/REPAIRED TO ORIGINAL CONDITION.
4. AT CONTRACTOR'S OPTION, HDPE, STEEL SCH 20, AND C900 PVC (BELOW GRADE ONLY) PIPE MATERIAL WITH LINING SYSTEM RATED FOR SEWAGE SERVICE MAY BE USED IN LIEU OF DUCTILE IRON PIPE MATERIAL FOR PIPING AND FITTINGS 4" AND ABOVE WHEN APPROVED BY ENGINEER. CONTRACTOR RESPONSIBLE FOR COSTS ASSOCIATED WITH ALL MODIFICATIONS AND DESIGN CHANGES ASSOCIATED WITH USE OF A DIFFERENT PIPE MATERIAL THAN THE DESIGN.

CONTROL POINTS

DESIGNATION	NORTHING	EASTING	ELEVATION
7013	686516.40	588614.80	184.78
7003	687173.62	587028.79	180.98
7023	689755.80	586281.24	182.65
7051	690801.00	584322.34	183.75
7052	690811.69	584841.51	184.93
7053	692212.73	584440.49	183.17

NOTES:
1. ALL CONTROL POINTS ARE REBAR SET IN CONCRETE.
2. CONTRACTOR TO VERIFY CONTROL POINT COORDINATES AND ELEVATIONS PRIOR TO BEGINNING CONSTRUCTION.

ALABAMA LICENSED
Nicholas D Freeman
No. 33224
PROFESSIONAL ENGINEER
NICHOLAS D. FREEMAN
Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, e=nicholas.freeman@jacobs.com
Date: 2023.07.20 13:24:32 -05'00'

AEROBIC DIGESTER FACILITY
SEE DWG 60-SM-141

PLANT DRAIN PUMP STATION

HEADWORKS

TREATMENT UNITS

CORROSION CONTROL SYSTEM

4027-187 6" DR 6" DEC 6" DS 14" RS 14" RS IE 187.89 6" WYE N 686097.35 E 589185.38 IE 186.71 4" TEE WITH PLUG (ROTATED UPWARD) N 686072.46 E 589192.11 IE 188.59 6" DR 4" TEE 3" V-130 4"-45° BEND (VERTICAL) N 686071.14 E 589190.79 IE 190.46 6" SSM 4" WAS 6" DR/DEC 6" WYE N 686079.58 E 589167.61 IE 186.04 6" SSM IE 187.41 4" W3 14" RS 6" DS 6" DS 4" W3 8"-11 1/4° BEND (VERTICAL) N 686133.53 E 589091.45 IE 186.36 8"-11 1/4° BEND (VERTICAL) N 686144.05 E 589080.93 IE 189.32 8" W1 8"-11 1/4° BEND (VERTICAL) N 686119.39 E 589105.59 IE 186.36 8"-11 1/4° BEND (VERTICAL) N 686109.12 E 589115.86 IE 189.25 12" DR PLANT DRAIN MH 1 N 686121.53 E 589060.91 RIM EL 193.60 IE 12" (N) 187.04 IE 10" (SW) 185.43 IE 12" (SE) 185.29 15" STORM 12" DR 4" DR 10"X4" WYE AND 4"- 45° BEND (ROTATED UPWARD) N 686101.75 E 589041.13 IE 185.50 4"-45° BEND (VERTICAL) N 686101.49 E 589039.59 IE 187.44 15" STORM 10" DR

4" SLEEVE 3311-775 4" V-500 4027-641 8" W1 4" DI W3 N 686 048.82 E 589 168.66 4" TEE RJ IE 190.56 6" DR/DEC 4" SLEEVE 3/4" W3 SEE ENLARGED PLAN ON DWG 56-D-201 SEE ENLARGED PLAN ON DWG 12-D-201 N 686 036.16 E 589 134.36 6" TEE IE 189.19 N 686 032.90 E 589 131.10 90° BEND IN VERTICAL 6" DI PDD N 686 017.72 E 589 116.12 90° BEND IE 189.19 N 686 014.56 E 589 119.07 90° BEND IN VERTICAL 6"-45° BEND N 686059.50 E 589108.15 IE 188.58 4"-45° BEND N 686059.24 E 589110.72 IE 188.67 6" DR 6" PDD IE 190.65 SCHEDULE A SCHEDULE B SCHEDULE A SCHEDULE B 16" DI RS

SURFACE RESTORATION APPROXIMATE LIMITS 3123-110 3123-115 3213-245

14" RS 8" W1 189.89 3311-765 N 686 000.24 E 589 217.24 4" 90° BEND RJ IE 190.56 4" DI W3 14" RS IE 187.17 8"-45° BEND N 685986.62 E 589238.36 IE 190.12 8" W1 FIRE HYDRANT N 685966.46 E 589242.87 IE 189.39 3312-950X 8"X6" TEE N 685966.46 E 589238.36 IE 189.83 8"-45° BEND N 685946.31 E 589238.36 IE 189.52 8" W1 N 685 956.90 E 589 220.86 49'-8" R 25'-0" 1 1/2" W3 EXTERIOR HOSE VALVE 4027-150 HOSE RACK 2210-720 N 685 958.10 E 589 187.16 12'-0" GRAVEL 8" THICK 6" CLEAN OUT 4027-187 N 685 944.70 E 589 165.12 6" WYE RJ IE 184.07 6" DI DR 6" V-405 4027-641 6" SLEEVE N 685 944.71 E 589 161.75 6" WYE IE 184.07 N 685 965.85 E 589 156.84 SEE ENLARGED PLAN ON DWG 12-D-202 6" SLEEVE R 25'-0" N 685 913.06 E 589 177.02 8" W1

PLAN
1"=10'

NO.	DSGN	DATE	DR	REVISION	CHK	APVD	BY	APVD
		M LAKEMAN	P HAMERLICK		N FREEMAN	N FREEMAN		N FREEMAN

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

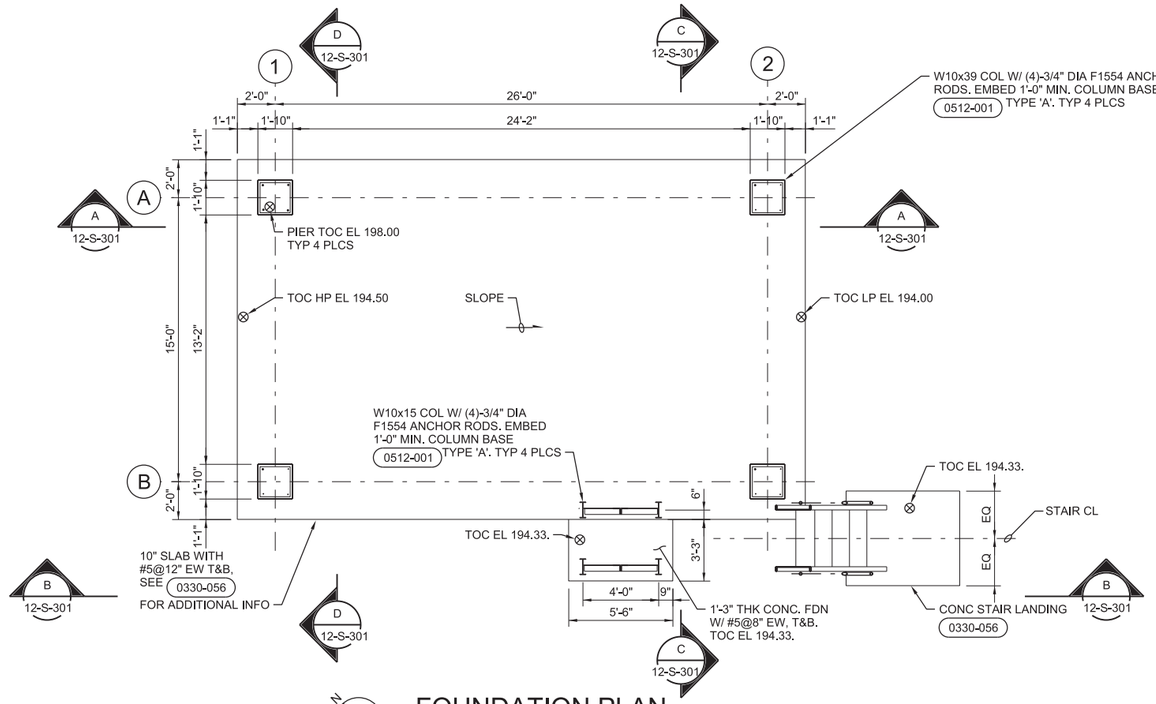
Jacobs

PROCESS MECHANICAL
YARD PIPING PLAN

BID DOCUMENTS

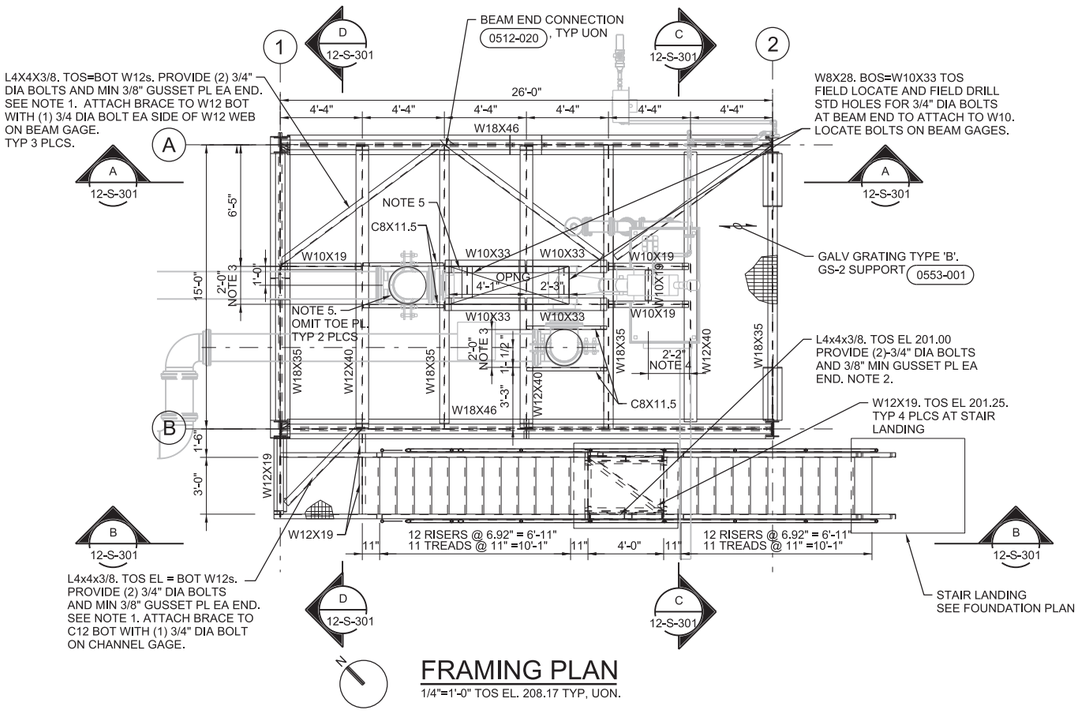
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	05-Y-201
SHEET	09 of 32



FOUNDATION PLAN

1/4"=1'-0"



FRAMING PLAN

1/4"=1'-0" TOS EL. 208.17 TYP, UON.

NOTES:
1. FASTEN GUSSET PLATE TO INTERSECTING BEAMS AT BRACE WORK POINT USING ANGLES (1/4" MIN THICKNESS) WITH MIN (3) BOLTS EA SIDE.
2. FASTEN GUSSET PLATE TO INTERSECTING BEAMS AT BRACE WORK POINT USING ANGLES (1/4" MIN THICKNESS) WITH MIN (2) BOLTS EA SIDE.
3. CONTRACTOR COORDINATE BEAM LOCATIONS WITH SCREEN SUPPORT LOCATIONS AND PIPING SUPPORT ON APPROVED EQUIPMENT AND PIPING SHOP DWGS PRIOR TO FABRICATION.
4. CONTRACTOR COORDINATE BEAM LOCATION WITH SCREEN CHUTE SUPPORT ON APPROVED SCREEN EQUIPMENT SHOP DWGS PRIOR TO FABRICATION.
5. GRTG OPNG. BAND GRTG EDGES WITH TOE PL EXTENDING 4" ABOVE TOP OF GRTG. COORDINATE OPENING SIZE WITH APPROVED EQPT AND PIPING SHOP DWGS PRIOR TO FABRICATION.

ALABAMA LICENSED
No. 49218
PROFESSIONAL
ENGINEER
KENNETH MICHAEL DANE
7/20/2023

GENERAL NOTES

1. FOR DESIGN CRITERIA AND ADDITIONAL INFORMATION SEE STRUCTURAL GENERAL NOTES
2. SEE 99-S SERIES DRAWINGS FOR STANDARD DETAILS
3. BRACE WORK POINTS ON BEAM AND/OR COLUMN CENTERLINES, UON.
4. ALL STEEL SHALL BE HOT DIPPED GALVANIZED UON.

NO.	DATE	DR	CHK	REVISION	APVD	BY
DSGN	E ALMANASEER	A KONIOR	G PETTY		APVD	K DANE

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

STRUCTURAL
NEW SCREENS PLANS

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
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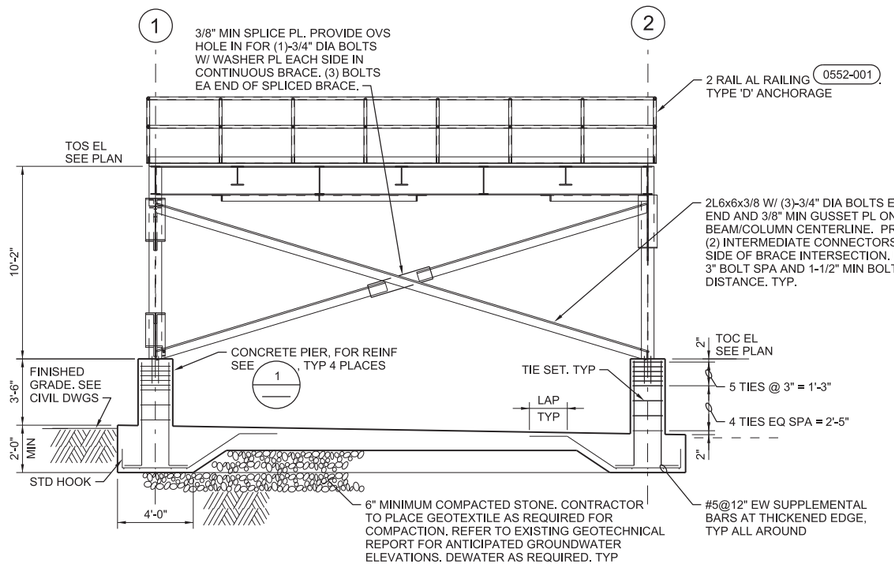
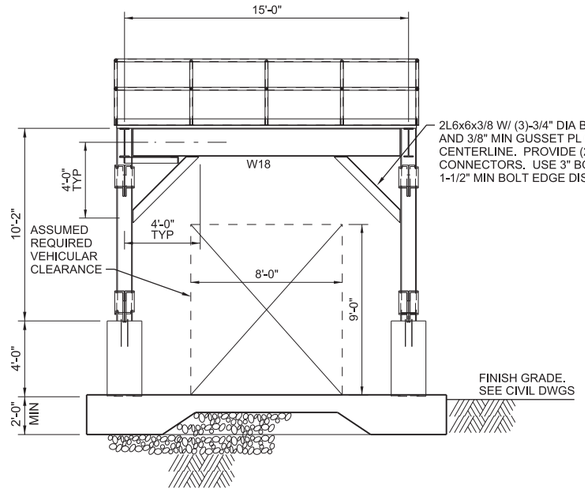
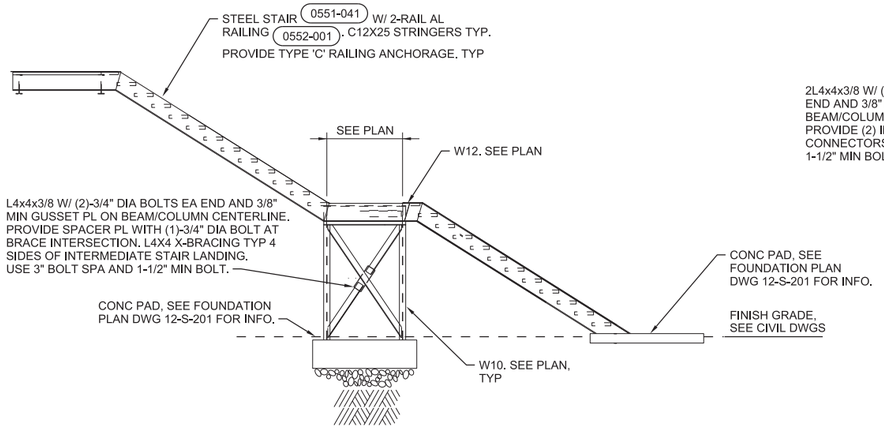


A SECTION
1/4"=1'-0"
12-S-201

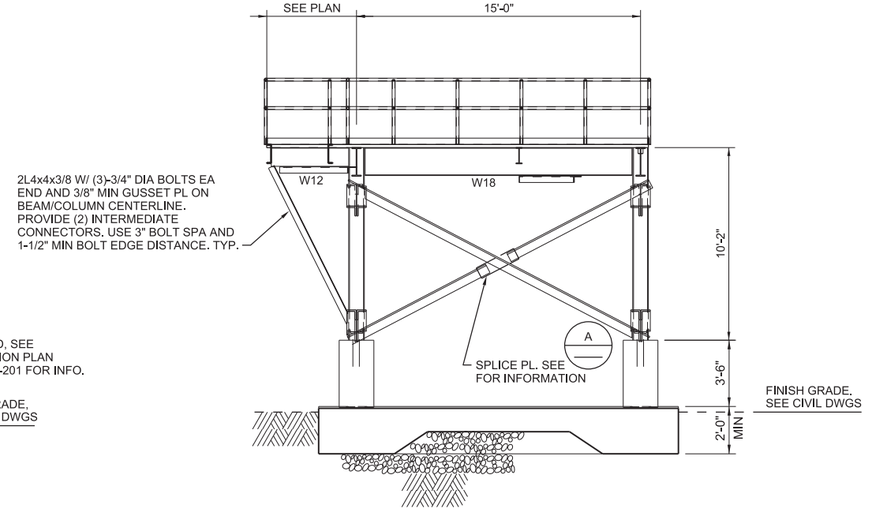


NOTE: SEE SECTION A FOR ADDITIONAL INFORMATION.

C SECTION
1/4"=1'-0"
12-S-201

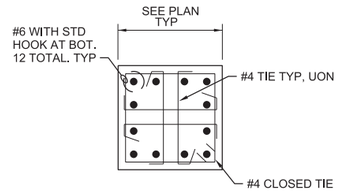


B SECTION
1/4"=1'-0"
12-S-201



NOTE: SEE SECTION A FOR ADDITIONAL INFORMATION.

D SECTION
1/4"=1'-0"
12-S-201



1 DETAIL
NTS

ALABAMA LICENSED No. 42217 PROFESSIONAL 11/20/2023 KENNETH MICHAEL DANE ENGINEER

GENERAL NOTES

1. FOR DESIGN CRITERIA AND ADDITIONAL INFORMATION SEE STRUCTURAL GENERAL NOTES
2. SEE 99-S SERIES DRAWINGS FOR STANDARD DETAILS
3. BRACE WORK POINTS ON BEAM AND/OR COLUMN CENTERLINES, UON.
4. ALL STEEL SHALL BE HOT DIPPED GALVANIZED UON.

NO.	DATE	DR	REVISION	CHK	APVD	BY	APVD
DSGN	E ALMANASEER	A KONIOR		G PETTY		K DANE	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

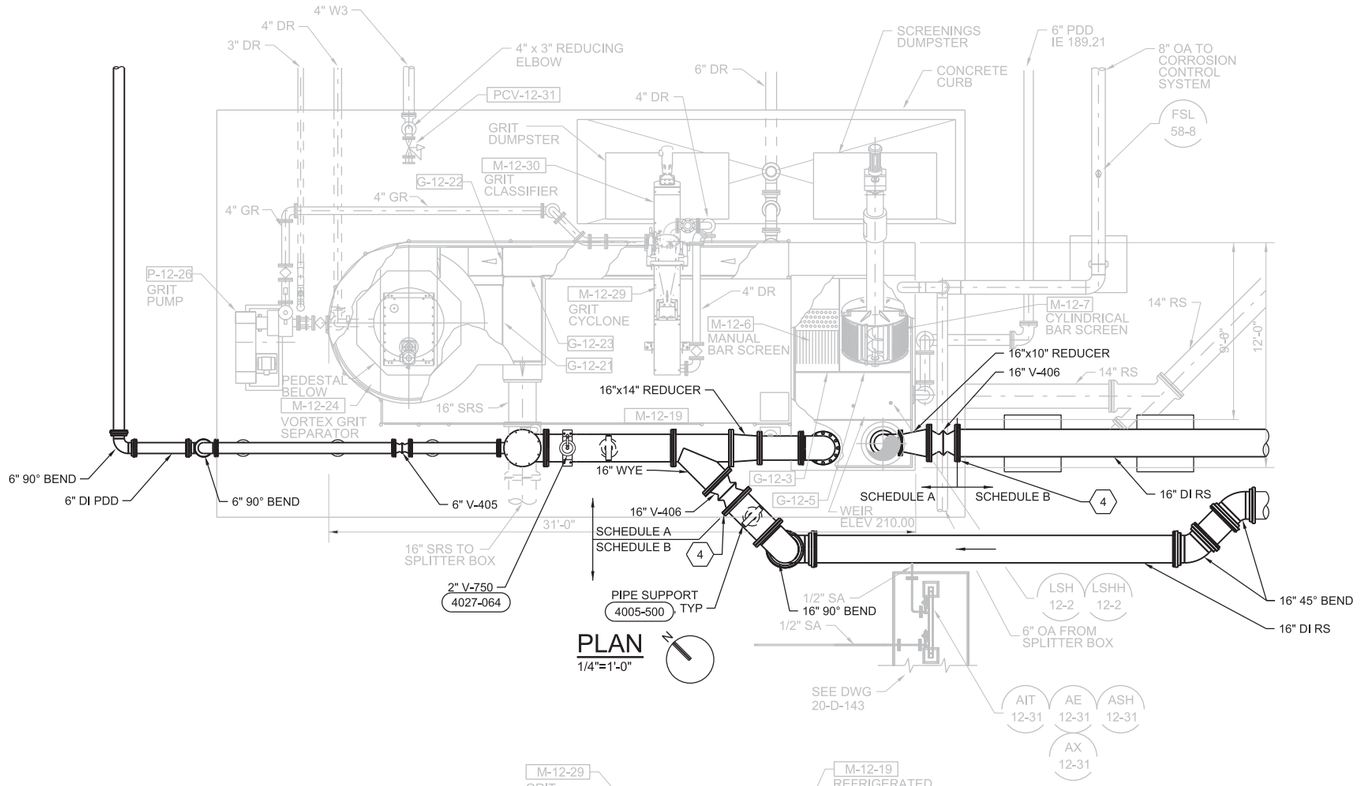
Jacobs

STRUCTURAL
NEW SCREENS
SECTIONS AND DETAIL

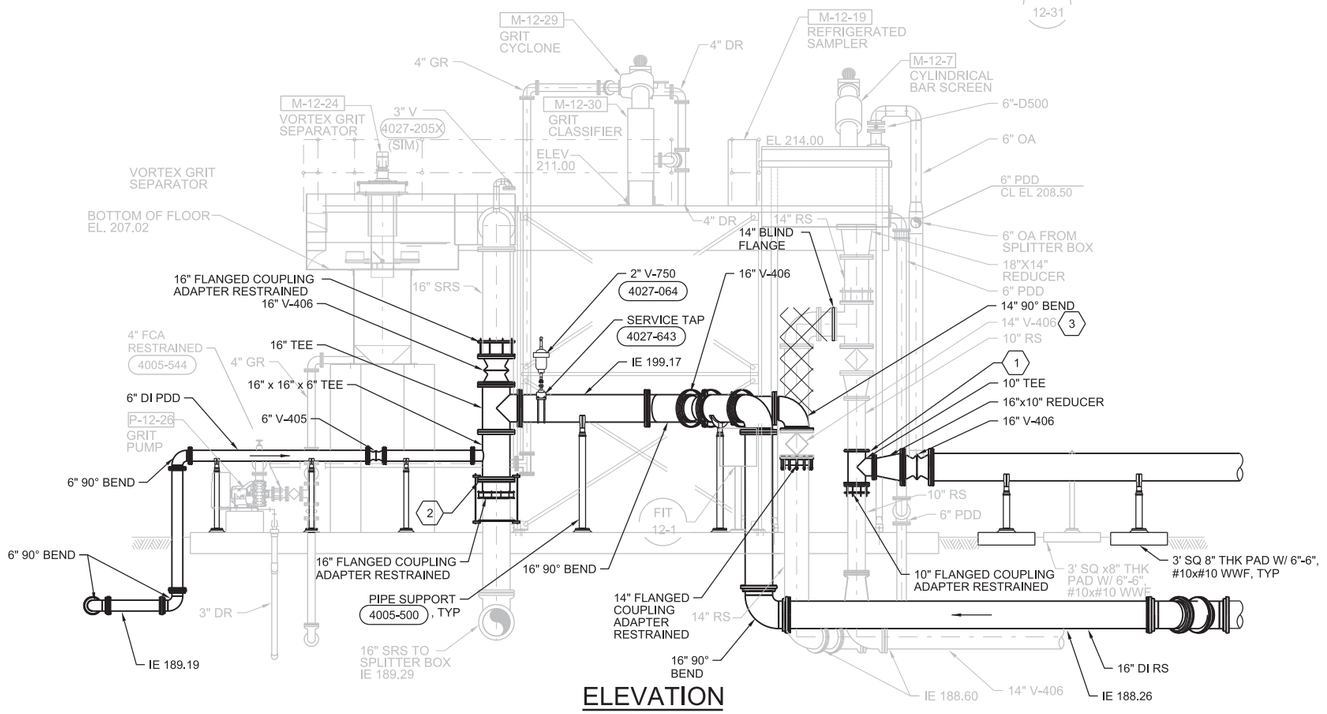
BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	12-S-301
SHEET	11 of 32



PLAN
1/4"=1'-0"



ELEVATION
1/4"=1'-0"

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SHEET KEYNOTES

1. REMOVE EXISTING 10" FLOW METER AND REPLACE WITH 10" TEE.
2. REMOVE SECTION OF 16" SCREENED RAW SEWAGE PIPING AND INSTALL NEW PIPING AS SHOWN.
3. REUSE EXISTING 14" VALVE. MODIFY PIPING AS SHOWN.
4. INSTALL 16" BLIND FLANGE AFTER COMPLETION OF SCHEDULE A WORK

Nicholas D Freeman
ALABAMA LICENSED No. 33222 PROFESSIONAL ENGINEER NICHOLAS D. FREEMAN
Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
2023.07.19 10:11:45 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION
		M LAKEMAN	P HAMMERLIK	N FREEMAN	APVD	N FREEMAN	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

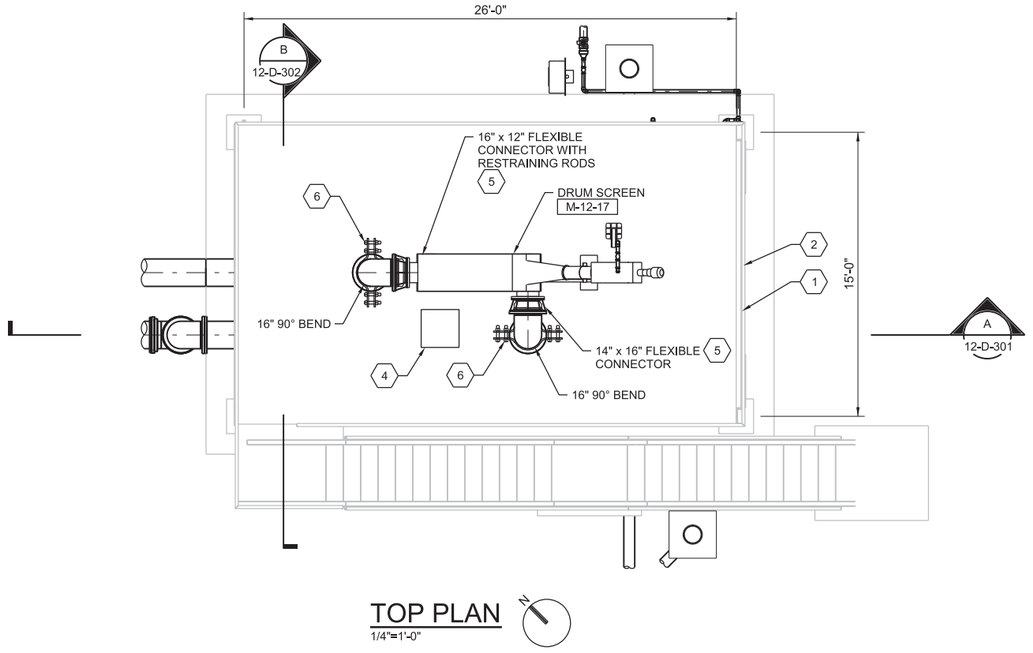
Jacobs

PROCESS MECHANICAL
HEADWORKS
PLAN AND SECTION

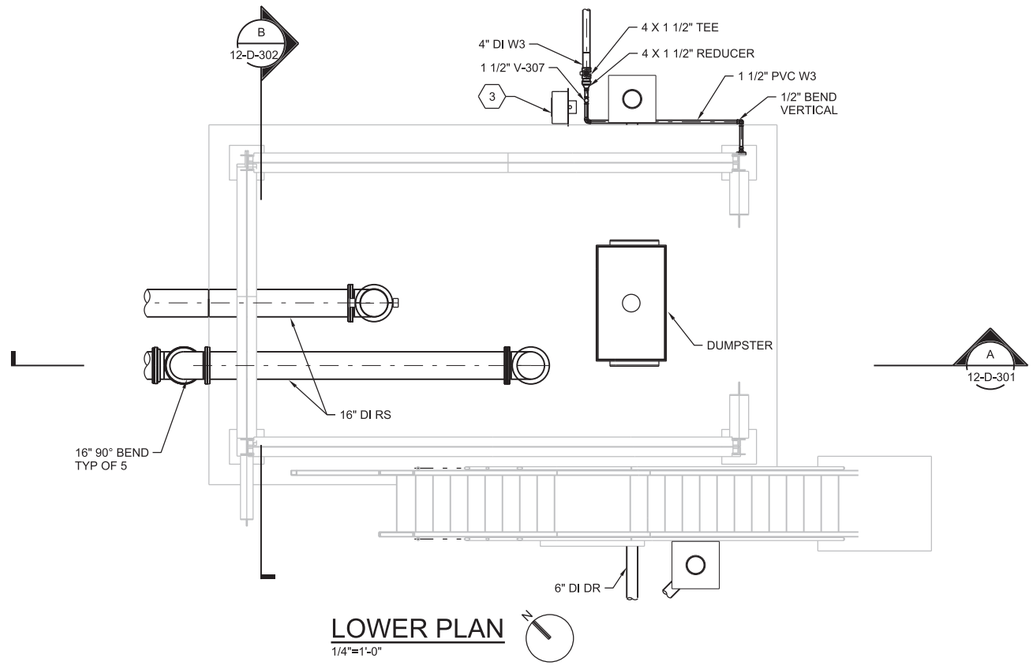
BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	12-D-201
SHEET	12 of 32



TOP PLAN
1/4"=1'-0"



LOWER PLAN
1/4"=1'-0"

GENERAL NOTES

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4. AT CONTRACTOR'S OPTION, HDPE, STEEL SCH 20, AND C900 PVC (BELOW GRADE ONLY) PIPE MATERIAL WITH LINING SYSTEM RATED FOR SEWAGE SERVICE MAY BE USED IN LIEU OF DUCTILE IRON PIPE MATERIAL FOR PIPING AND FITTINGS 4" AND ABOVE WHEN APPROVED BY ENGINEER. CONTRACTOR RESPONSIBLE FOR COSTS ASSOCIATED WITH DESIGN CHANGES.

SHEET KEYNOTES

1. SCREEN PLATFORM FLOOR ELEVATION: 208.33 FT.
2. PROVIDE ALUMINUM PLATFORMS AND GRATING IN ORDER TO PROVIDE OPERATION ACCESS ACROSS THE ELEVATED PORTION OF THE HEADWORKS STRUCTURE. GRATING SHALL BE INSTALLED TO ALLOW OPERATIONS AND MAINTENANCE ACCESS TO EACH PIECE OF EQUIPMENT. PROVIDE HANDRAIL AROUND ALL ELEVATED PLATFORMS.
3. PROVIDE 1-1/2" HOSE BIB AND HOSE RACK PER DETAIL 2210-720 AND 4027-150. INSTALL HOSE BIB ADJACENT TO SCREENING DUMPSTERS.
4. CONTRACTOR SHALL RELOCATE THE INFLUENT REFRIGERATED SAMPLER FROM THE EXISTING HEADWORKS SYSTEM TO THE NEW SCREENING SYSTEM. SAMPLER TO DRAW SAMPLE FROM TANK ASSEMBLY SAMPLING PORT PER SPECIFICATION 44 42 30. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL LABOR AND MATERIALS REQUIRED TO MOVE AND TEST SAMPLER FOR PROPER OPERATION AT NEW LOCATION.
5. PROVIDE STANDARD FLEXIBLE CONNECTOR WITH RESTRAINING RODS PER SPECIFICATION 40 27 01.
6. CONTRACTOR SHALL PROVIDE PIPE RISER SUPPORT PER SPECIFICATION 40 05 15.
7. SOLENOID VALVE AND W3 CONNECTION LAYOUT IS BASED ON THE LAYOUT FOR ROTOMAT RO9 MICRO STRAINER. SOLENOID VALVES TO BE PROVIDED BY SCREEN MANUFACTURER. CONTRACTOR SHALL BE RESPONSIBLE FOR MODIFICATIONS FOR APPROVED EQUAL EQUIPMENT. ALL PROCESS MECHANICAL MODIFICATIONS ARE TO BE APPROVED BY THE ENGINEER. CONTRACTOR SHALL PROVIDE PIPE SUPPORT FOR W3 PIPING TO SOLENOID VALVES ACCORDINGLY.

ALABAMA LICENSED PROFESSIONAL ENGINEER
Nicholas D Freeman
No. 33222
PROFESSIONAL
NICHOLAS D. FREEMAN ENGINEER
Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
Date: 2023.07.19 10:12:00 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	REVISION	BY	APVD
		M LAKEMAN	P HAMERLIK	N FREEMAN	N FREEMAN		N FREEMAN	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

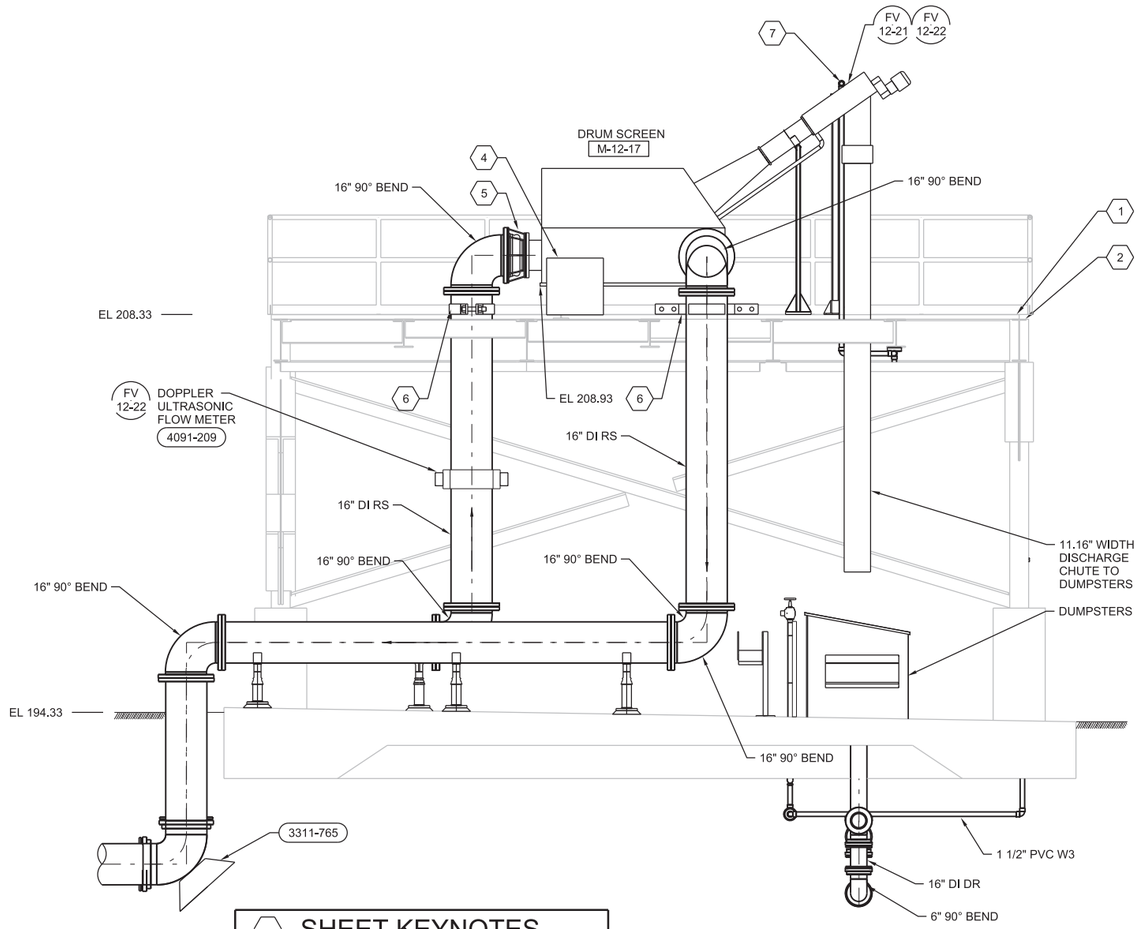
Jacobs

PROCESS MECHANICAL
NEW SCREENS PLAN

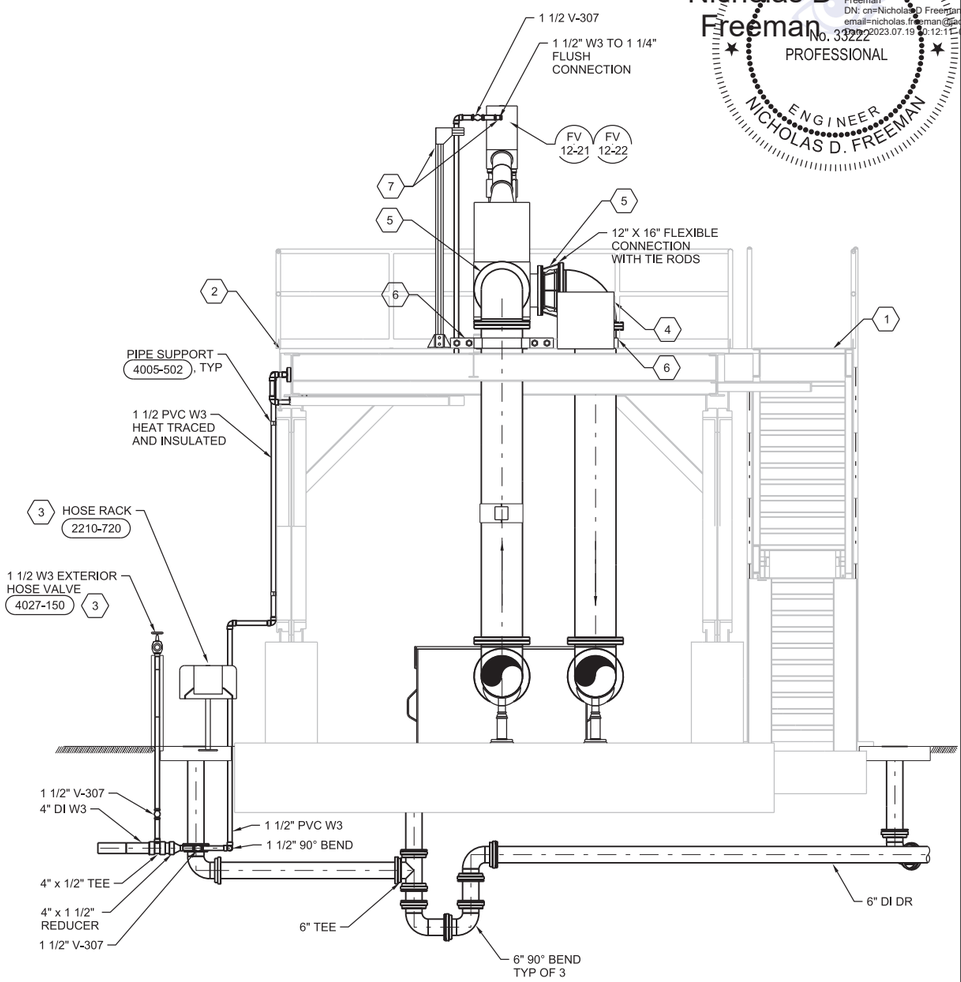
BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	12-D-202
SHEET	13 of 32



A SECTION
3/8"=1'-0"
20-D-201



B SECTION
3/8"=1'-0"
20-D-201

GENERAL NOTES

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SHEET KEYNOTES

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5. PROVIDE FLEXIBLE CONNECTOR WITH RESTRAINING RODS PER SPECIFICATION 40 27 01.
6. CONTRACTOR SHALL PROVIDE PIPE RISER SUPPORT PER SPECIFICATION 40 05 15.
7. SOLENOID VALVE AND W3 CONNECTION LAYOUT IS BASED ON THE LAYOUT FOR ROTOMAT RO9 MICRO STRAINER. SOLENOID VALVES TO BE PROVIDED BY SCREEN MANUFACTURER. CONTRACTOR SHALL BE RESPONSIBLE FOR MODIFICATIONS FOR APPROVED EQUAL EQUIPMENT. ALL PROCESS MECHANICAL MODIFICATIONS ARE TO BE APPROVED BY THE ENGINEER. CONTRACTOR SHALL PROVIDE PIPE SUPPORT FOR W3 PIPING TO SOLENOID VALVES ACCORDINGLY.

ALABAMA LICENSED
Nicholas D Freeman
No. 33222
PROFESSIONAL ENGINEER
NICHOLAS D. FREEMAN

Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
2023.07.19 10:12:11 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION
	M LAKEMAN	P HAMERLIK	N FREEMAN	N FREEMAN	APVD	N FREEMAN	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

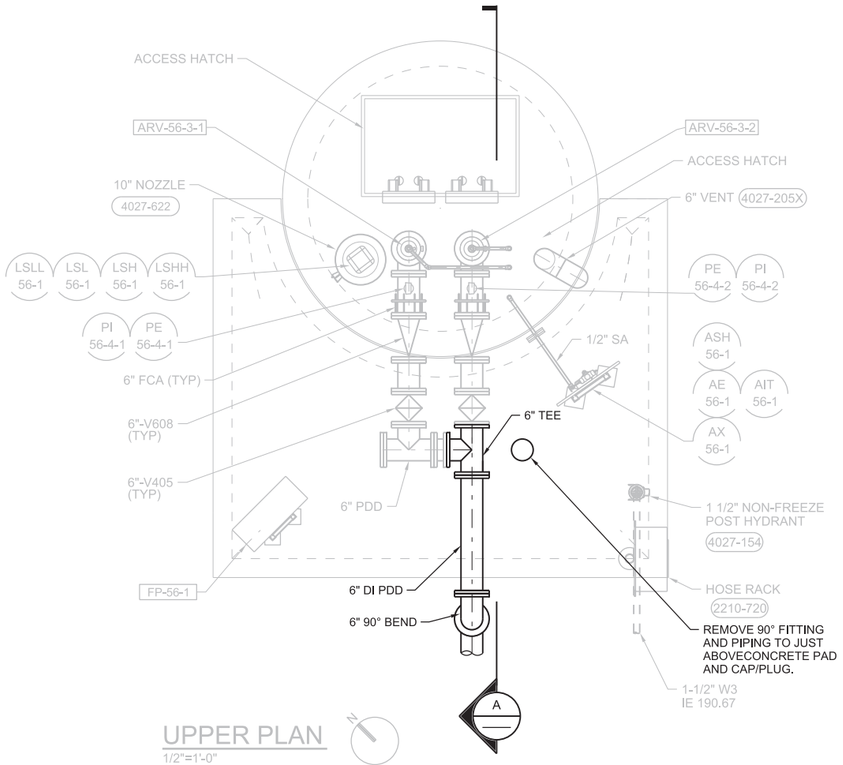
Jacobs

PROCESS MECHANICAL
NEW SCREENS SECTIONS

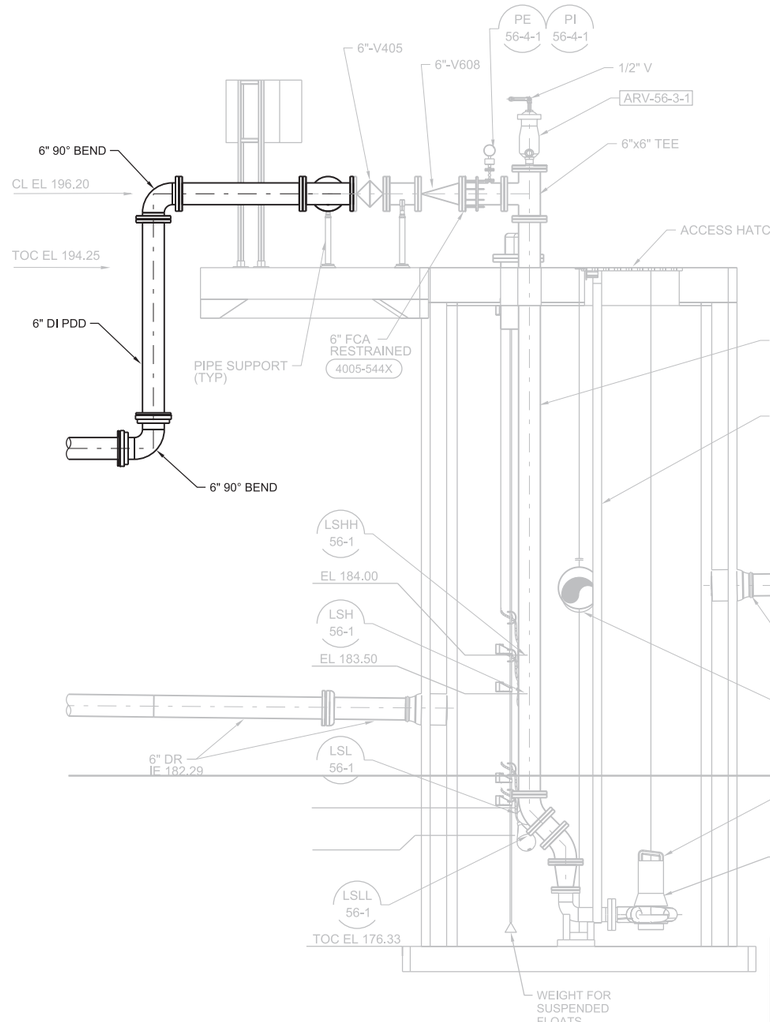
BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

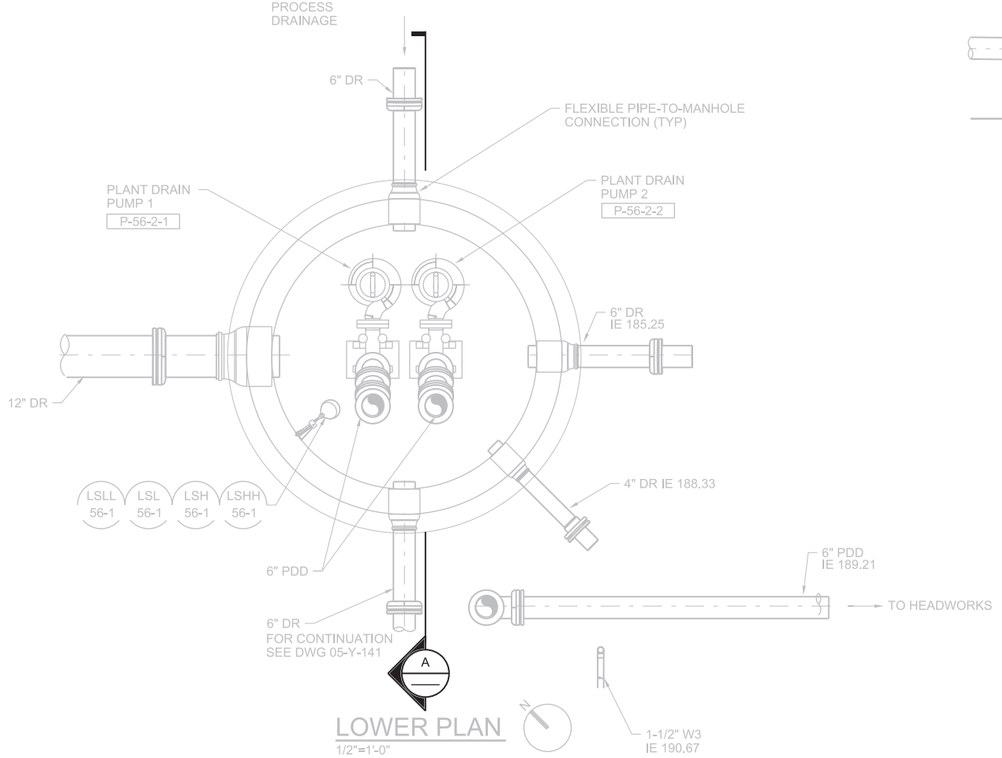
DATE	JULY 2023
PROJ	D3571200
DWG	12-D-301
SHEET	14 of 32



UPPER PLAN
1/2"=1'-0"



A SECTION
1/2"=1'-0"



LOWER PLAN
1/2"=1'-0"

GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL ELEVATIONS, LOCATIONS AND DIMENSIONS PRIOR TO COMMENCING WORK. ALL ELEVATIONS, LOCATIONS, AND DIMENSIONS SHOWN ARE APPROXIMATE AND BASED ON RECORD DRAWINGS.
2. CONTINUOUS OPERATION OF OWNER'S FACILITIES IS OF CRITICAL IMPORTANCE. CONTRACTOR TO ENSURE SCHEDULE AND CONDUCT OF ACTIVITIES ALLOW EXISTING FACILITIES TO OPERATE CONTINUOUSLY, UNTIL STARTUP OF NEW FACILITIES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SHORING, BRACING, CUTTING, FITTING, AND PATCHING REQUIRED TO COMPLETE THE WORK OR TO RESTORE WORK WHICH HAS BEEN CUT OR REMOVED FROM ITS ORIGINAL CONDITION THAT IS INDICATED TO REMAIN. ALL ADJACENT EXISTING WORK IN PLACE SHALL BE PROTECTED FROM DAMAGE DUE TO ANY NEW CONSTRUCTION AND/OR REPLACED/REPAIRED TO ORIGINAL CONDITION.
4. AT CONTRACTOR'S OPTION, HDPE, STEEL SCH 20, AND C900 PVC (BELOW GRADE ONLY) PIPE MATERIAL WITH LINING SYSTEM RATED FOR SEWAGE SERVICE MAY BE USED IN LIEU OF DUCTILE IRON PIPE MATERIAL FOR PIPING AND FITTINGS 4" AND ABOVE WHEN APPROVED BY ENGINEER. CONTRACTOR RESPONSIBLE FOR COSTS ASSOCIATED WITH DESIGN CHANGES.

ALABAMA LICENSED
Nicholas D. Freeman
No. 30222
PROFESSIONAL ENGINEER
NICHOLAS D. FREEMAN

Nicholas D Freeman
Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, e=nicholas.freeman@jacobs.com
Date: 2023.07.19 14:12:27 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION	CHK	APVD	BY
		M LAKEMAN	P HAMERLIK	N FREEMAN	N FREEMAN					

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

PROCESS MECHANICAL
PLANT DRAIN PUMP STATION
PLANT AND SECTION

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	56-D-201
SHEET	15 of 32

GENERAL NOTES

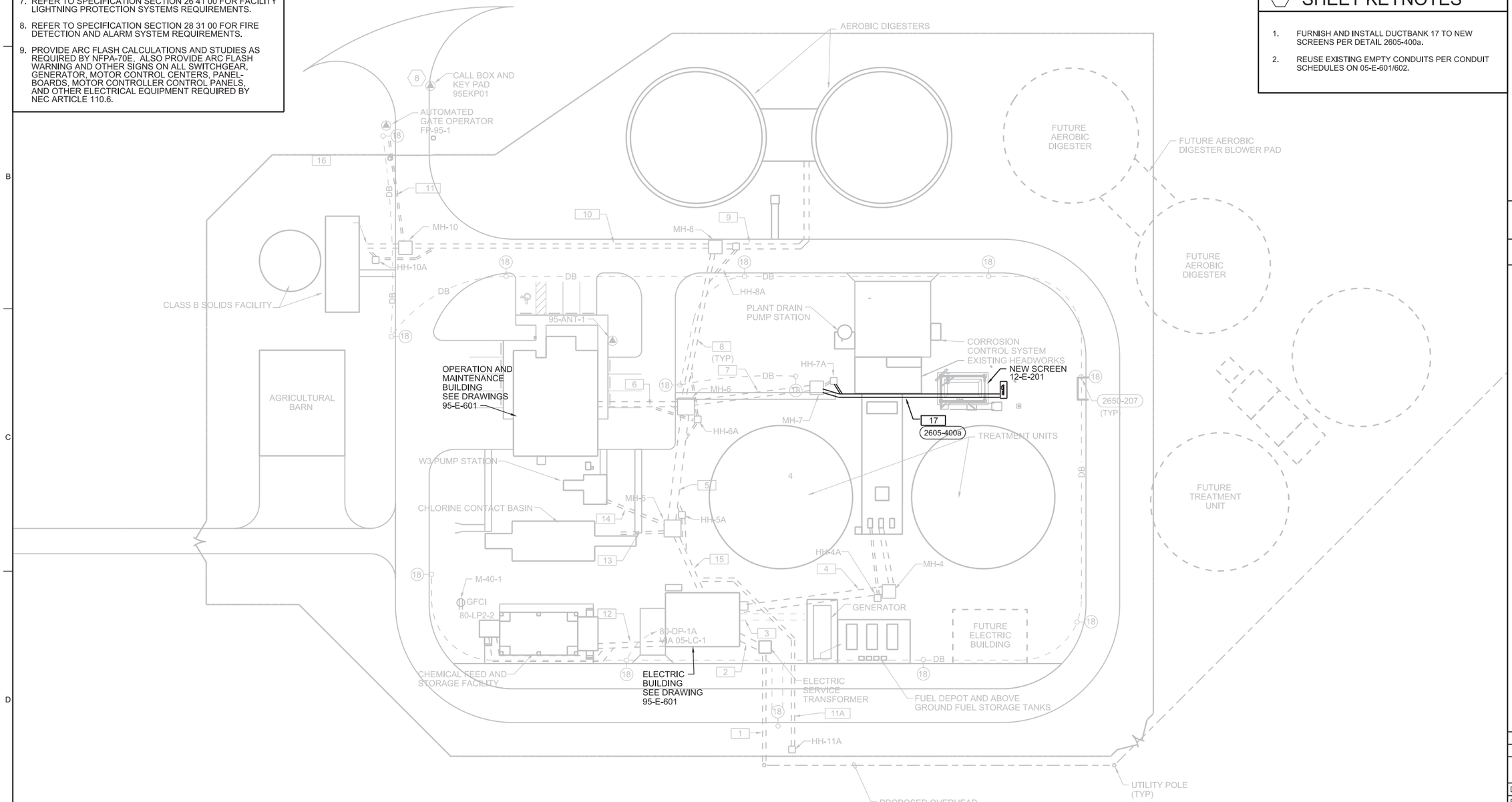
1. DO NOT SCALE ELECTRICAL DRAWINGS. REFER TO THE CIVIL, ARCHITECTURAL, MECHANICAL, AND STRUCTURAL DRAWINGS AND APPROVED MANUFACTURE'S SHOP DRAWINGS FOR THE EXACT LOCATION OF ALL EQUIPMENT.
2. ALL WORK SHALL COMPLY WITH NEC AND LOCAL CODES.
3. CONDUCTORS SHALL NOT BE SPLICED EXCEPT AS NOTED IN SPECIFICATIONS OR SHOWN ON THE DRAWINGS.
4. ALL CONDUITS SHALL HAVE AN EQUIPMENT GROUNDING CONDUCTOR SIZED PER TABLE 250.122 OF THE NEC UNLESS OTHERWISE NOTED.
5. CONTRACTOR SHALL FIELD VERIFY EXISTING UNDERGROUND UTILITIES, PIPING, ETC. AND REROUTE NEW CONDUITS, DUCTBANKS ETC., AS REQUIRED.
6. DO NOT INSTALL ANY CONDUITS, DUCTBANKS, PULLBOXES, MANHOLES, LIGHT POLES, CONTROL PANELS ETC., IN AREAS DESIGNATED FOR FUTURE STRUCTURES.
7. REFER TO SPECIFICATION SECTION 26 41 00 FOR FACILITY LIGHTNING PROTECTION SYSTEMS REQUIREMENTS.
8. REFER TO SPECIFICATION SECTION 28 31 00 FOR FIRE DETECTION AND ALARM SYSTEM REQUIREMENTS.
9. PROVIDE ARC FLASH CALCULATIONS AND STUDIES AS REQUIRED BY NFPA-70E. ALSO PROVIDE ARC FLASH WARNING AND OTHER SIGNS ON ALL SWITCHGEAR, GENERATOR, MOTOR CONTROL CENTERS, PANEL-BOARDS, MOTOR CONTROLLER CONTROL PANELS, AND OTHER ELECTRICAL EQUIPMENT REQUIRED BY NEC ARTICLE 110.6.

David C. Nicholson
CN=David C. Nicholson,
OU=Engineering, O=Jacobs
Engineering Group Inc.,
L=Dallas, S=Texas, C=US
2023.07.19 17:16:54-04'00'

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

SHEET KEYNOTES

1. FURNISH AND INSTALL DUCTBANK 17 TO NEW SCREENS PER DETAIL 2605-400a.
2. REUSE EXISTING EMPTY CONDUITS PER CONDUIT SCHEDULES ON 05-E-601/602.



NO.	DATE	REVISION	DR	CHK	BY
	T TWIST	V MCCORVEY	APVD	D NICHOLSON	APVD D NICHOLSON

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

ELECTRICAL
PLANT SITE PLAN

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	05-E-201
SHEET	16 of 32

DUCT BANK ID	FROM	TO	CONDUIT SIZE (IN INCHES)	DESCRIPTION	ELECTRICAL DRAWING REFERENCE	PID REFERENCE	(also in DB)	COMMENTS
	P-75-30-1	80-MCC-1A	1.5	480V Power	75-E-141	I-13	16,15,10,8	
	HS-75-30-1(RESET) HS-75-30-1(OOR) PSH-75-31-1 TPS-75-30-1							
	MSH-75-30-1	80-MCC-1A	1	120V Control	75-E-141	I-13	16,15,10,8	
	P-75-30-2	80-MCC-1B	1.5	480V Power	75-E-141	I-13	16,15,10,8	
	HS-75-30-2(RESET) HS-75-30-2(OOR) PSH-75-31-2 TPS-75-30-2							
	MSH-75-30-2	80-MCC-1B	1	120V Control	75-E-141	I-13	16,15,10,8	
	B-75-1-1	80-MCC-1A	1.25	480V Power	75-E-141	I-5	16,15,10,8	
	HS-75-1-1(RESET) HS-75-1-1(OOR) TSH-75-2-1 PSH-75-2-1 TPS-75-1-1							
	MSH-75-1-1	80-MCC-1A	1	120V Control	75-E-141	I-5	16,15,10,8	
	B-75-1-2	80-MCC-1B	1.25	480V Power	75-E-141	I-5	16,15,10,8	
	HS-75-1-2(RESET) HS-75-1-2(OOR) TSH-75-2-2 PSH-75-2-2 TPS-75-1-2							
	MSH-75-1-2	80-MCC-1B	1	120V Control	75-E-141	I-5	16,15,10,8	
	Lights Area 60	80-LP-1	1	208V Lighting	60-E-142		15,9,8	
	Light Switch Area 60 Recept Area 60	50-LC-2 80-LP-1	1	120V Lighting	60-E-142		15,9,8	
	B-60-1-1	80-MCC-1A	1.5	480V Power	60-E-142	I-5	15,9,8	
	HS-60-1-1(RESET) HS-60-1-1(OOR) TSH-60-2-1 PSH-60-2-1 TPS-60-1-1							
	MSH-60-1-1	80-MCC-1A	1	120V Control	60-E-142	I-5	15,9,8	Control for B-60-1-1
	B-60-1-2	80-MCC-1B	1.5	480V Power	60-E-142	I-5	15,9,8	
	HS-60-1-2(RESET) HS-60-1-2(OOR) TSH-60-2-2 PSH-60-2-2 TPS-60-1-2							
	MSH-60-1-2	80-MCC-1B	1	120V Control	60-E-142	I-5	15,9,8	Control for B-60-1-2
	B-60-1-3	80-MCC-1A	1.5	480V Power	60-E-142	I-5	15,9,8	
	HS-60-1-3(RESET) HS-60-1-3(OOR) TSH-60-2-3 PSH-60-2-3 TPS-60-1-3							
	MSH-60-1-3	80-MCC-1A	1	120V Control	60-E-142	I-5	15,9,8	Control for B-60-1-3
	P-60-9-1	80-MCC-1A	1	480V Power	60-E-142	I-12	15,9,8	
	HS-60-9-1(OOR)							
	MSH-60-9-1	80-MCC-1A	1	120V Control	60-E-142	I-12	15,9,8	
	P-60-9-2	80-MCC-1B	1	480V Power	60-E-142	I-12	15,9,8	
	HS-60-9-2(OOR							
	MSH-60-9-2	80-MCC-1B	1	120V Control	60-E-142	I-12	15,9,8	
	MM-60-5-1	80-MCC-1A	1	480V Power	60-E-141	I-12	15,9,8	
5	HS-60-5-1(OOR)							
	TSH-60-5-1	80-MCC-1A	1	120V Control	60-E-141	I-12	15,9,8	
	XS-60-5-1	80-MCC-1A	1	Analog Control	60-E-141	I-12	15,9,8	
	MM-60-6-1	80-MCC-1A	1	480V Power	60-E-141	I-12	15,9,8	
	HS-60-6-1(OOR)							
	TSH-60-6-1	80-MCC-1A	1	120V Control	60-E-141	I-12	15,9,8	
	XS-60-6-1	80-MCC-1A	1	Analog Control	60-E-141	I-12	15,9,8	
	MM-60-5-2	80-MCC-1B	1	480V Power	60-E-141	I-12	15,9,8	
	HS-60-5-2(OOR)							
	TSH-60-5-2	80-MCC-1B	1	120V Control	60-E-141	I-12	15,9,8	
	XS-60-5-2	80-MCC-1B	1	Analog Control	60-E-141	I-12	15,9,8	
	MM-60-6-2	80-MCC-1B	1	480V Power	60-E-141	I-12	15,9,8	
	HS-60-6-2(OOR)							
	TSH-60-6-2	80-MCC-1B	1	120V Control	60-E-141	I-12	15,9,8	
	XS-60-6-2	80-MCC-1B	1	Analog Control	60-E-141	I-12	15,9,8	
	Lights Area 12	80-LP-1	1	120V Lighting	12-E-141		15,7	
	Recept Area 12	80-LP-1	1	120V Recept	12-E-141		15,7	
	Recept Area 12	80-LP-1	1	Dedicated 30A Recept	12-E-141 & 20-E-142		15,7	
	FIT-12-1 AIT-12-31 AIT-58-9 FSL-58-8 AIT-56-1	80-LP-1	2	120V Inst. Power	12-E-141, 58-E-141, 56-E-141	I-1, I-11, I-14	15,7	
	M-12-19	80-LP-1	1	120V Inst. Power	12-E-141	I-1	15,7	
	FP-12-1	80-DP-1	1	480V Power	12-E-141	I-1	15,7	
	FP-12-2	80-DP-1	1	480V Power	12-E-141	I-1	15,7	
	FP-58-1	80-DP-1	1	480V Power	58-E-141	I-11	15,7	
	FP-56-1	80-MCC-1B	1	480V Power	56-E-141	I-14	15,7	
	16-DP-1	80-SWGR-1	2	480V Pwr	16-E-141	NA	15,6	
	CP-16-3	CP-80-1	4	Network	95-E-610	I-18	15,6	combine with above?
	CP-16-2	CP-80-1	4	Network	95-E-610	I-18	15,6	combine with above?
	16-FACP-1	80 FACP-1	1	Fire Alarm Sys	95-E-610	NA	15,6	separate conduit
	60-HT-1A, 1B, 1C, 1D, 1E	80-LP-2	1	120V Power	60-E-141		15,9,8	
	12-HT-1	80-LP-2	1	120V Power	12-E-141		15,7	
	56-HT-1				56-E-141			
	58-HT-1	80-LP-2	1	120V Power	58-E-141		15,7	combine at MH-7
	Duct Detector	80-FACP-1	1	Fire Alarm	58-E-141		15,7	
	50-JB-A (FIT-50-1 AIT-50-6 AIT-50-13-1 AIT-50-13-2 AIT-50-7 M-50-8)	CP-16-3	2	Analog Control	50-E-141	I-6	13,6	
	50-JB-D (P-50-5-1 P-50-5-2 M-50-8)	CP-16-3	2	120V Control	50-E-141	I-6	13,6	
	FIT-52-4 PIT-52-3	CP-16-3	1	Analog Control	52-E-141	I-9	14,6	
	MH-6 (FP-12-3)	**MH-5 (80-DP-1A)**	**2**	**480v Pwr**	**12-E-201**	**08-N-602**	**7, 15,17**	
	MH-6	MH-5	2	EMPTY				
	MH-6	MH-5	2	EMPTY				
	MH-6	MH-5	2	EMPTY				
	HH-6A	HH-5A	2	EMPTY				
	HH-6A	HH-5A	2	EMPTY				
	HH-6A	HH-5A	2	EMPTY				
	SERVICE POLE	HH-5A	2	BUSINESS LAN	HH-11A			
	SERVICE POLE	HH-5A	4	TELEPHONE	HH-11A			

DUCT BANK ID	FROM	TO	CONDUIT SIZE (IN INCHES)	DESCRIPTION	ELECTRICAL DRAWING REFERENCE	PID REFERENCE	(also in DB)	COMMENTS
	16-DP-1	80-SWGR-1	3	480V Pwr	16-E-141	NA	15,5	
	OWNER FURNISHED RACK	COM DEMARC HH-11A	2	Network	16-E-142	I-18	3, 10, 11	SCADA COMMUNICATIONS
	OWNER FURNISHED RACK	COM DEMARC HH-11A	2	Network	16-E-142	I-18	3, 10, 11	BUSINESS LAN
	CP-16-3	CP-80-1	4	Network	95-E-610	I-18	15,5	
	CP-16-2	CP-80-1	4	Network	95-E-610	I-18	15,5	combine with above?
	16-FACP-1	80 FACP-1	1	Fire Alarm Sys	95-E-610	NA	15,5	separate conduit
	50-JB-A (FIT-50-1 AIT-50-6 AIT-50-13-1 AIT-50-13-2 AIT-50-7 M-50-8)	CP-16-3	4	Discrete Control	50-E-141	I-6	13,5	
	50-JB-D (P-50-5-1 P-50-5-2 M-50-8)	CP-16-3	4	Analog Control	50-E-141	I-6	13,5	
	FP-95-1	16-LP-2	1	240V Power	05-E-141	I-17	11,10,8	entrance gate operator
	Lights Area 75	16-LP-1	1	120V Lighting	75-E-141		16,10,8	
	Recept Area 75	16-LP-1	1	120V Recpts	75-E-141		16,10,8	
6	FV-75-24 LSHH-75-20 LSHH-75-25 ZSC-75-32-1 ZSC-75-32-2	CP-16-3	2	120V Control	75-E-141	I-13	16,10,8	
	LIT-75-20 LIT-75-21 LIT-75-25	CP-16-3	2	Analog Control	75-E-141	I-13	16,10,8	
	FV-75-24	16-DP-1	1	480V Power	75-E-141	I-13	16,10,8	
	LIT-75-20	16-LP-1	1	120V Inst. Power	75-E-141	I-13	16,10,8	
	Area 60 60-JB-D (ZSC-60-11-1 ZSC-60-11-2)	CP-16-3	1	Discrete Control	60-E-142	I-12	9,8	
	Area 60 60-JB-A (LT-60-4-1 LT-60-4-2)	CP-16-3	1	Analog Control	60-E-142	I-12	9,8	
	FIT-12-1 M-12-19	CP-16-3	2	Analog Control	12-E-141	I-1	7	
	AIT-12-31 M-12-19 FP-12-1 FP-12-2 AIT-58-9 FSL-58-8 FP-58-1 AIT-56-1 FP-56-1	CP-16-3	4	120V Control	12-E-141, 58-E-141, 56-E-141	I-1, I-11, I-14	7	
	FIT-52-4 PIT-52-3	CP-16-3	1	Analog Control	52-E-141	I-9	14,5	
	FV-75-24	16-DP-1	1	480V Power	75-E-141	I-13	16,10,8	
	LIT-75-20	16-LP-1	1	120V Inst. Power	75-E-141	I-13	16,10,8	
	75-HT-1A, 1B, 1C	16-LP-1	1	120V Power	75-E-141		16,10,8	
	STUB UP(CP-16-3)	**MH-6 (M-12-19)**	**2**	**120V Inst. Power**	**12-E-201**	**08-N-602**	**7, 17**	
	STUB UP	MH-6	2					stub up in operations building electrical room
	STUB UP	MH-6	2					
	STUB UP (CP-16-3)	**HH-6A (FV-12-21)**	**2**	**Analog Control**	**12-E-201**	**08-N-602**	**7, 17**	
	AT&T	TELEPHONE	4, 2					
	Lights Area 12	80-LP-1	1	120V Lighting	12-E-141		15,5	
	Recept Area 12	80-LP-1	1	120V Recept	12-E-141		15,5	
	Recept Area 12	80-LP-1	1	Dedicated 30A Recept	12-E-141 & 20-E-142		15,5	
	FIT-12-1 AIT-12-31 AIT-58-9 FSL-58-8 AIT-56-1	80-LP-1	2	120V Inst. Power	12-E-141, 58-E-141, 56-E-141	I-1, I-11, I-14	15,5	Combine at HH-7A
	FIT-12-1 M-12-19	CP-16-3	2	Analog Control	12-E-141	I-1	6	Combine at HH-7A
	M-12-19	80-LP-1	1	120V Power	12-E-141	I-1	15,5	
7	AIT-12-31 M-12-19 FP-12-1 FP-12-2 AIT-58-9 FSL-58-8 FP-58-1 AIT-56-1 FP-56-1	CP-16-3	4	120V Control	12-E-141, 58-E-141, 56-E-141	I-1, I-11, I-14	6	Combine at HH-7A
	FP-12-1	80-DP-1	1	480V Power	12-E-141	I-1	15,5	
	FP-12-2	80-DP-1	1	480V Power	12-E-141	I-1	15,5	
	FP-58-1	80-DP-1	1	480V Power	58-E-141	I-11	15,5	
	FP-56-1	80-MCC-1B	1	480V Power	56-E-141	I-14	15,5	
	12-HT-1	80-LP-2	1	120V Power	12-E-141		15,5	
	56-HT-1 58-HT-1	80-LP-2	1	120V Power	56-E-141 58-E-141		15,5	combine at MH-7
	Duct Detector	80-FACP-1	1	Fire Alarm	58-E-141		15,5	
	MH-7(FP-12-3)	**MH-6 (80-DP-1A)**	**2**	**480V Pwr**	**12-E-201**	**08-N-602**	**5, 15, 17**	
	MH-7 (M-12-19)	**MH-6 (CP-16-3)**	**2**	**120V Inst. Power**	**12-E-201**	**08-N-602**	**5, 17**	
	HH-7A (FV-12-21)	**HH-6A (CP-16-3)**	**2**	**Analog Control**	**12-E-201**	**08-N-602**	**5, 17**	

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

GENERAL NOTES

1. REUSE EXISTING EMPTY CONDUITS BETWEEN MANHOLES AND HANDHOLES AS INDICATED.
2. CONTRACTOR TO CONFIRM ALL EMPTY CONDUITS AVAILABILITY PRIOR TO COMMENCING WORK.

David C. Nicholson
CN=David C. Nicholson,
OU=Engineering, O=Jacobs Engineering Group Inc.,
L=Dallas, S=Texas, C=US
2023.07.19 17:19:33-04'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY
		T TWIST	V MCCORVEY	D NICHOLSON	APVD	D NICHOLSON

REVISION

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

ELECTRICAL
DUCT BANK SYSTEM SCHEDULE
SHEET 1 OF 2

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	05-E-601
SHEET	17 of 32

BID DOCUMENTS

DUCT BANK ID	FROM	TO	CONDUIT SIZE (IN INCHES)	DESCRIPTION	ELECTRCAL DRAWING REFERENCE	PID REFERENCE	(also in DB)	COMMENTS
	P-75-30-1	80-MCC-1A	1.5	480V Power	75-E-141	I-13	16,10,8,5	
	HS-75-30-1(RESET) HS-75-30-1(OOR) PSH-75-31-1 TPS-75-30-1 MSH-75-30-1	80-MCC-1A	1	120V Control	75-E-141	I-13	16,10,8,5	
	P-75-30-2	80-MCC-1B	1.5	480V Power	75-E-141	I-13	16,10,8,5	
	HS-75-30-2(RESET) HS-75-30-2(OOR) PSH-75-31-2 TPS-75-30-2 MSH-75-30-2	80-MCC-1B	1	120V Control	75-E-141	I-13	16,10,8,5	
	B-75-1-1	80-MCC-1A	1.5	480V Power	75-E-141	I-5	16,10,8,5	
	HS-75-1-1(RESET) HS-75-1-1(OOR) TSH-75-2-1 PSH-75-2-1 TPS-75-1-1 MSH-75-1-1	80-MCC-1A	1	120V Control	75-E-141	I-5	16,10,8,5	
	B-75-1-2	80-MCC-1A	1.25	480V Power	75-E-141	I-5	16,10,8,5	
	HS-75-1-2(RESET) HS-75-1-2(OOR) TSH-75-2-2 PSH-75-2-2 TPS-75-1-2 MSH-75-1-2	80-MCC-1A	1	120V Control	75-E-141	I-5	16,10,8,5	
	Lights Area 60	80-LP-1	1	208V Lighting	60-E-142		9,8,5	
	Light switch Area 60 Recept Area 60	80-LC-2 80-LP-1	1	120V Lighting	60-E-142		9,8,5	
	B-60-1-1	80-MCC-1A	1.5	480V Power	60-E-142	I-5	9,8,5	
	HS-60-1-1(RESET) HS-60-1-1(OOR) TSH-60-2-1 PSH-60-2-1 TPS-60-1-1 MSH-60-1-1	80-MCC-1A	1	120V Control	60-E-142	I-5	9,8,5	Control for B-60-1-1
	B-60-1-2	80-MCC-1B	1.5	480V Power	60-E-142	I-5	9,8,5	
	HS-60-1-2(RESET) HS-60-1-2(OOR) TSH-60-2-2 PSH-60-2-2 TPS-60-1-2 MSH-60-1-2	80-MCC-1B	1	120V Control	60-E-142	I-5	9,8,5	Control for B-60-1-2
	B-60-1-3	80-MCC-1A	1.5	480V Power	60-E-142	I-5	9,8,5	
	HS-60-1-3(RESET) HS-60-1-3(OOR) TSH-60-2-3 PSH-60-2-3 TPS-60-1-3 MSH-60-1-3	80-MCC-1A	1	120V Control	60-E-142	I-5	9,8,5	Control for B-60-1-3
	P-60-9-1	80-MCC-1A	1	480V Power	60-E-142	I-12	9,8,5	
	HS-60-9-1(OOR) MSH-60-9-1	80-MCC-1A	1	120V Control	60-E-142	I-12	9,8,5	
	P-60-9-2	80-MCC-1B	1	480V Power	60-E-142	I-12	9,8,5	
	HS-60-9-2(OOR) MSH-60-9-2	80-MCC-1B	1	120V Control	60-E-142	I-12	9,8,5	
	MM-60-5-1	80-MCC-1A	1	480V Power	60-E-141	I-12	9,8,5	
	HS-60-5-1(OOR) TSH-60-5-1	80-MCC-1A	1	120V Control	60-E-141	I-12	9,8,5	
	XS-60-5-1	80-MCC-1A	1	Analog Control	60-E-141	I-12	9,8,5	
	MM-60-6-1	80-MCC-1A	1	480V Power	60-E-141	I-12	9,8,5	
15	HS-60-6-1(OOR) TSH-60-6-1	80-MCC-1A	1	120V Control	60-E-141	I-12	9,8,5	
	XS-60-6-1	80-MCC-1A	1	Analog Control	60-E-141	I-12	9,8,5	
	MM-60-5-2	80-MCC-1B	1	480V Power	60-E-141	I-12	9,8,5	
	HS-60-5-2(OOR) TSH-60-5-2	80-MCC-1B	1	120V Control	60-E-141	I-12	9,8,5	
	XS-60-5-2	80-MCC-1B	1	Analog Control	60-E-141	I-12	9,8,5	
	MM-60-6-2	80-MCC-1B	1	480V Power	60-E-141	I-12	9,8,5	
	HS-60-6-2(OOR) TSH-60-6-2	80-MCC-1B	1	120V Control	60-E-141	I-12	9,8,5	
	XS-60-6-2	80-MCC-1B	1	Analog Control	60-E-141	I-12	9,8,5	
	Lights Area 12	80-LP-1	1	120V Lighting	12-E-141		7,5	
	Recept Area 12	80-LP-1	1	120V Recept	12-E-141		7,5	
	Recept Area 12	80-LP-1	1	Dedicated 30A Recept	12-E-141		7,5	
	FIT-12-1 AIT-12-31 AIT-58-9 FSL-58-8 AIT-56-1	80-LP-1	2	120V Inst. Power	12-E-141, 58-E-141, 56-E-141	I-1, I-11, I-14	7,5	
	M-12-19	80-LP-1	1	120V Inst. Power	12-E-141	I-1	7,5	
	FP-12-1	80-DP-1	1	480V Power	12-E-141	I-1	7,5	
	FP-12-2	80-DP-1	1	480V Power	12-E-141	I-1	7,5	
	FP-58-1	80-DP-1	1	480V Power	58-E-141	I-11	7,5	
	FP-56-1	80-MCC-1B	1	480V Power	56-E-141	I-14	7,5	
	16-DP-1	80-SWGR-1	3	480V Pwr	16-E-141	NA	6,5	
	CP-16-3	CP-80-1	4	Network	95-E-610	I-18	6,5	
	CP-16-2	CP-80-1	4	Network	95-E-610	I-18	6,5	combine with above?
	16-FACP-1	80 FACP-1	1	Fire Alarm Sys	95-E-610	NA	6,5	separate conduit
	60-HT-1A, 1B, 1C, 1D, 1E	80-LP-2	1	120V Power	60-E-141		9,8,5	
	12-HT-1	80-LP-2	1	120V Power	12-E-141		7,5	
	56-HT-1 58-HT-1	80-LP-2	1	120V Power	56-E-141 58-E-141		7,5	combine at MH-7
	Duct Detector	80-FACP-1	1	Fire Alarm	58-E-141		7,5	
	Lights Area 50 Recept Area 50	80-LP-1	1	120V Power	50-E-141	na	13	
	ME-50-9 50-HT-1 ME-50-11	80-LP-2	1	120V Power	50-E-141	na	13	
	FIT-50-1 AIT-50-6 AIT-50-13-1 AIT-50-13-2 AIT-50-7	80-LP-1	2	120V Inst. Power	50-E-141	I-6	13	
	P-50-5-1	80-LP-1	1	120V Power	50-E-141	I-6	13	
	P-50-5-2	80-LP-1	1	120V Power	50-E-141	I-6	13	
	M-50-8	80-LP-1	1	120V Power	50-E-141	I-6	13	
	LCP-52-2	80-LP-1	1	120V Inst. Power	52-E-141	I-9	14	
	LCP-52-2	CP-16-3	1	120V Control	52-E-141	I-9	14	
	FIT-52-4	80-LP-1	1	120V Inst. Power	52-E-141	I-9	14	
	P-52-1-1	80-MCC-1A	2	480V Pwr	52-E-141	I-9	14	
	HS-52-1-1 TSH-52-1-1 MSH-52-1-1	80-MCC-1A	1	120V Control	52-E-141	I-9	14	
	P-52-1-2	80-MCC-1B	2	480V Pwr	52-E-141	I-9	14	
	HS-52-1-2 TSH-52-1-2 MSH-52-1-2	80-MCC-1B	1	120V Control	52-E-141	I-9	14	
	P-52-1-3	80-MCC-1A	2	480V Pwr	52-E-141	I-9	14	
	HS-52-1-3 TSH-52-1-3 MSH-52-1-3	80-MCC-1A	1	120V Control	52-E-141	I-9	14	

DUCT BANK ID	FROM	TO	CONDUIT SIZE (IN INCHES)	DESCRIPTION	ELECTRICAL DRAWING REFERENCE	PID REFERENCE	(also in DB)	COMMENTS
	52-HT-1	80-LP-2	1	120V Power	52-E-141		14	
	MH-5	80-MCC-1A	2	EMPTY				
	MH-5	80-MCC-1A	2	EMPTY				
	MH-5	80-MCC-1A	2	EMPTY				
	MH-5	80-MCC-1B	2	EMPTY				
15 (CONT	MH-5	80-MCC-1B	2	EMPTY				
	MH-5	80-MCC-1B	2	EMPTY				
	MH-5 (FP-12-3)	80-DP-1A	2	480V Pwr	05-E-201	08-N-602	5, 7, 17	
	HH-5A	80-LP-1	2	EMPTY				
	HH-5A	CP-80-1	2	EMPTY				Stub up in electrical building
	HH-5A	CP-80-1	2	EMPTY				
	FP-12-3	MH-7 (80-DP-1A)	2	480V Pwr	12-E-201	08-N-602	5, 7, 15	
	M-12-19	MH-7 (CP-16-3)	2	120V Inst. Power	12-E-201	08-N-602	6, 7	
17	FV-12-21	HH-7A (CP-16-3)	2	Analog Control	12-E-201	08-N-602	6, 7	

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

GENERAL NOTES

1. CONTRACTOR TO USE EXISTING EMPTY CONDUITS BETWEEN MANHOLES AND HANDHOLES.
2. CONTRACTOR TO CONFIRM AVAILABILITY OF ALL EMPTY CONDUITS PRIOR TO COMMENCING WORK

David C. Nicholson
CN=David C. Nicholson,
OU=Engineering, O=Jacobs
Engineering Group Inc.,
L=Dallas, S=Texas, C=US
2023.07.19 17:20:54-04'00'

NO.	DATE	REVISION	DR	CHK	APVD	BY	APVD
	T TWIST		V MCCORVEY	D NICHOLSON	D NICHOLSON		D NICHOLSON

REUSE OF DOCUMENTS:

BID DOCUMENTS

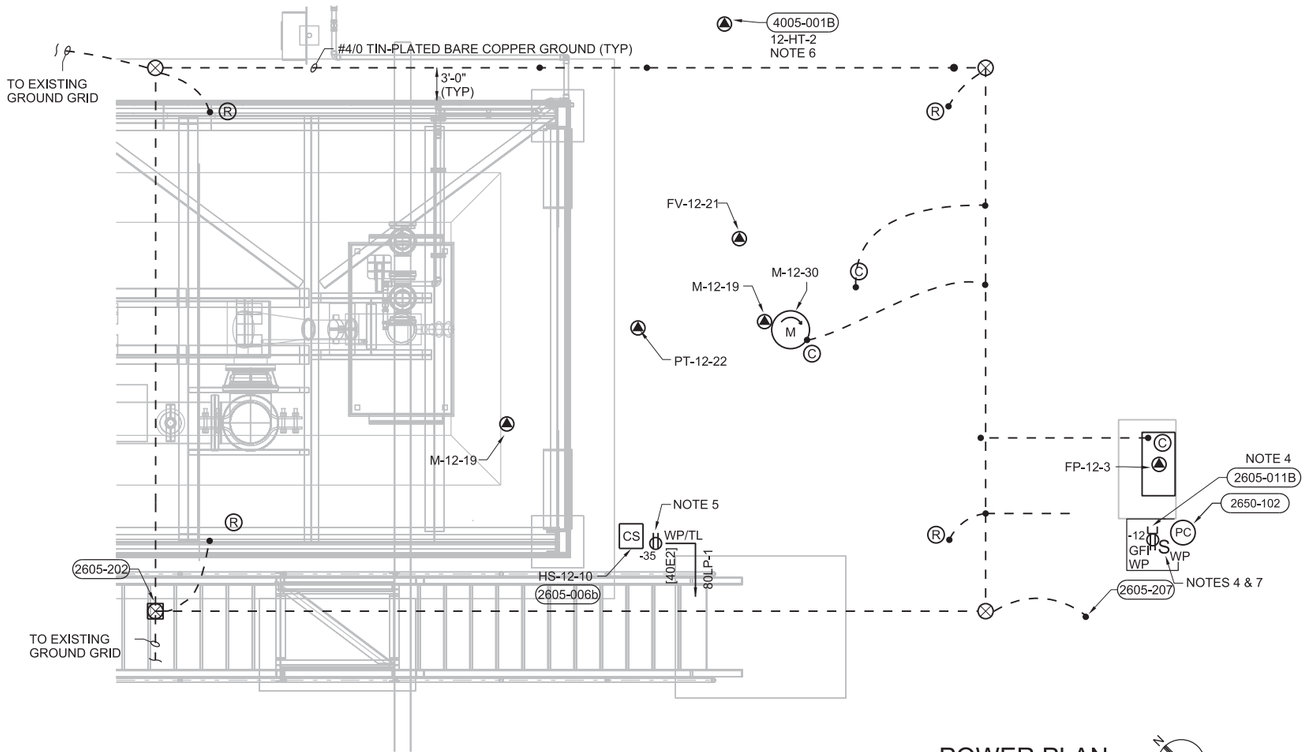
MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

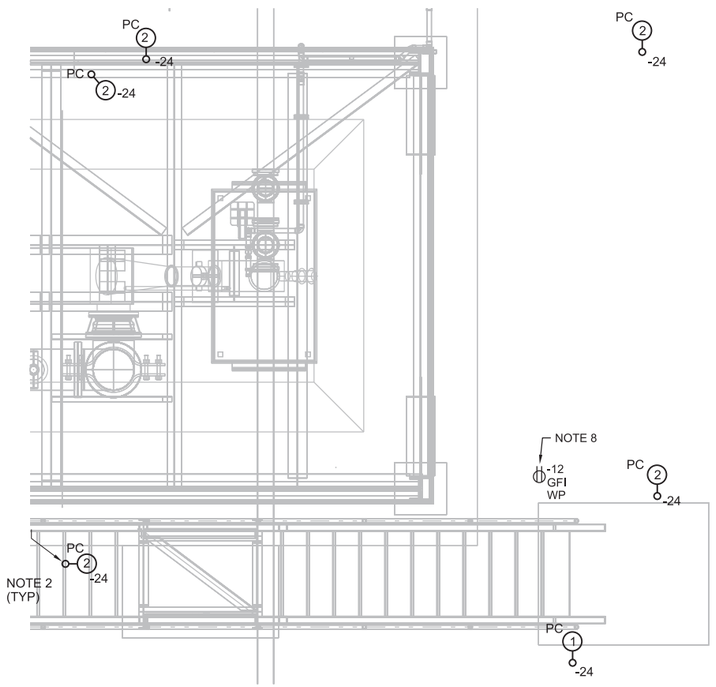
ELECTRICAL
DUCT BANK SYSTEM SCHEDULE
SHEET 1 OF 2

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	05-E-602
SHEET	18 of 32



POWER PLAN
1/4"=1'-0"



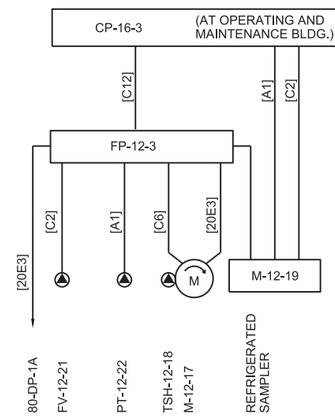
LIGHTING PLAN
1/4"=1'-0"

HAZARDOUS LOCATION NOTES

1. PER NFPA 820, TABLE 5.2, ROW 1, LINE A & C, AND ROW 4, LINE A & C, THE HEADWORKS AREA IS CLASSIFIED AS A HAZARDOUS LOCATION AS FOLLOWS:
   a) ENTIRE ENCLOSED SPACE IS CONSIDERED CLASS I, DIVISION 1 LOCATION.
   b) ENVELOPE 18 INCHES ABOVE THE TOP OF THE CHANNEL, BAR SCREENS, AND VORTEX GRIT SEPARATOR AND EXTENDING 18 INCHES BEYOND THE EXTERIOR WALL OF THE STRUCTURE AND ENVELOPE 18 INCHES ABOVE GRADE EXTENDING 10 FT HORIZONTALLY FROM EXTERIOR WALL OF THE STRUCTURE IS CONSIDERED CLASS I, DIVISION 2 LOCATION.
   c) ALL AREAS UNDERNEATH THE STRUCTURE IS CONSIDERED CLASS I, DIVISION 2 LOCATION.
   d) THE AREA BEYOND THE ENVELOPES ARE UNCLASSIFIED.
2. PROVIDE SUITABLE WIRING METHODS AND MATERIALS FOR HAZARDOUS LOCATIONS PER NFPA 70 (NEC).
3. PER NFPA 820, TABLE 5.2, ROW 3, LINES A & C, THE SPLITTER BOX AREA IS CLASSIFIED AS A HAZARDOUS LOCATION AS FOLLOWS:
   a) THE AREA WITHIN THE ENCLOSED SPLITTER BOX IS CONSIDERED A CLASS I, DIVISION 1 LOCATION.
   b) ENVELOPE 18 INCHES ABOVE THE TOP OF THE CHANNEL AND EXTENDING 18 INCHES BEYOND THE EXTERIOR WALL OF THE STRUCTURE AND ENVELOPE 18 INCHES ABOVE GRADE EXTENDING 10 FT HORIZONTALLY FROM EXTERIOR WALL OF THE STRUCTURE IS CONSIDERED A CLASS 1, DIVISION 2 LOCATION.
   c) THE AREA BEYOND THE ENVELOPE IS UNCLASSIFIED.

CORROSIVE LOCATION NOTE

1. THE HEADWORKS AND SPLITTER BOX ARE CONSIDERED CORROSIVE AREAS.



RISER DIAGRAM

NOTES:

1. MOUNT THE BOTTOM OF THE LUMINAIRE AT 8'-0" ABOVE GRADE.
2. STANCHION MOUNT LUMINAIRES ON UPPER PLATFORM WITH BOTTOM AT 8'-0" ABOVE PLATFORM.
3. PROVIDE MOUNTING PEDESTAL FOR LIGHT SWITCH, PHOTOCELL, AND RECEPTACLE OUTSIDE OF HAZARDOUS AREAS.
4. LUMINAIRES AND RECEPTACLES SHALL BE POWERED FROM PANELBOARD 80LP1. CIRCUITS 12 AND 24. LUMINAIRES SHALL BE CONTROLLED VIA LIGHT SWITCH AND PHOTOCELL MOUNTED ON 1" CONDUIT STANCHION AT 6' ABOVE GRADE. PROVIDE [30E2] ENTIRE LENGTH OF RUN.
5. NEMA L5-30R TWIST LOCK RECEPTACLE FOR PORTABLE GATE VALVE OPERATOR MOUNTED AT 48 INCHES ON TOP OF HANDRAIL. SEE DETAIL 2605-006B
6. PROVIDE HEAT TRACE FOR EXPOSED W3 PIPING. PROVIDE [20E2] WIRING FROM 12-HT-1 TO 12-HT-2.
7. RECEPTACLES MOUNTED AT 48" AFG, WITH WEATHER-PROOF DIE-CAST METAL COVERS, U.L. LISTED FOR WET LOCATIONS WHILE IN USE. REFER TO SECTION 26 27 26, WIRING DEVICES FOR ADDITIONAL REQUIREMENTS.
8. RECEPTACLE MOUNTED AT 48 INCHES ON TOP OF HANDRAIL, SEE DETAIL PROVIDE WITH WEATHER-PROOF DIE-CAST METAL COVER, UL LISTED FOR WET LOCATIONS WHILE IN USE. REFER TO SECTION 26 27 26, WIRING DEVICES FOR ADDITIONAL REQUIREMENTS.

2605-006B

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

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OU=Engineering,
O=Jacobs Engineering Group Inc., L=Dallas,
S=Texas, C=US
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NO.	DATE	DR	REVISION	CHK	APVD	BY	APVD
DSGN	T TWIST	V MCCORVEY		D NICHOLSON	D NICHOLSON		D NICHOLSON

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

ELECTRICAL
HEADWORKS POWER AND LIGHTING PLANS

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	12-E-201
SHEET	19 of 32

PANEL: 80-DP-1A | LOCATION: ELECTRICAL BUILDING
VOLTAGE: 480 | PHASE: 3 | WIRE: 3
TOTAL LOAD KVA: 160.6 | BUS SIZE: 400 | MAIN SIZE: 250 | TYPE: CB
REMARKS: | NEUTRAL: | MOUNTING: SURFACE
NEMA 1 ENCLOSURE, TVSS

LOAD IN KVA A	LOAD IN KVA B	LOAD IN KVA C	CIRCUIT DESCRIPTION	BKR A/P	CKT NO.	CKT NO.	BKR A/P	CIRCUIT DESCRIPTION	LOAD IN KVA A	LOAD IN KVA B	LOAD IN KVA C
1.0			FP-12-1	20/3	1	2	150/3	80-LP-1 VIA 80-TR-1	20.7		
	1.0				3	4				18.8	
		1.0			5	6					19.8
3.3			FP-12-2	20/3	7	8	15/3	41-U-H-1 at Chem Feed	2.5		
	3.3				9	10				2.5	
		3.3			11	12					2.5
2.5			FP-58-1	20/3	13	14	15/3	43-U-H-1 at Chem Feed	2.5		
	2.5				15	16				2.5	
		2.5			17	18					2.5
3.5			90-DP-1	30/3	19	20	15/3	80-CU-1	3.1		
	3.5				21	22				3.1	
		3.5			23	24					3.1
0.6			80-APU-1	20/3	25	26	15/3	80-CU-2	3.1		
	0.6				27	28				3.1	
		0.6			29	30					3.1
7.6			80-LP-2 VIA 80-TR-2	30/3	31	32	20/2	AREA LIGHTS VIA 05-LC-1	1.2		
	9.3				33	34				1.2	
		12.8			35	36	-	Space			0.0
1.0			FP-12-3 (1) (2)	20/3	37	38	30/3	TVSS			
	1.0				39	40					
		1.0			41	42					
19.5	21.2	24.7	TOTAL						33.1	31.2	31.0

PANEL: 80-LP-1 (Section 2) | LOCATION: ELECTRICAL BUILDING
VOLTAGE: 120Y/208 | PHASE: 3 | WIRE: 4
TOTAL LOAD KVA: 22.9 | BUS SIZE: 400 | MAIN SIZE: 400 | TYPE: MLO
REMARKS: NEMA 1 ENCLOSURE | NEUTRAL: FULL | MOUNTING: SURFACE
* INDICATES PGFI CB, ** INDICATES EGFI CB

LOAD IN KVA A	LOAD IN KVA B	LOAD IN KVA C	CIRCUIT DESCRIPTION	BKR A/P	CKT NO.	CKT NO.	BKR A/P	CIRCUIT DESCRIPTION	LOAD IN KVA A	LOAD IN KVA B	LOAD IN KVA C
0.3			AIT-12-31 Headworks	20/1	1	2	20/1	FP-20-21	0.5		
	0.3		AIT-50-13-1	20/1	3	4	20/1	LCP-52-2		0.6	
		0.3	AIT-50-13-2	20/1	5	6	20/1	80FACP-1			1.0
0.3			AIT-50-6	20/1	7	8	60/3	80-LP-UPS	2.7		
	0.3		FIT-12-1 Headworks	20/1	9	10	-	-		2.7	
		0.3	AIT-20-5-1	20/1	11	12	-	-			2.7
0.3			AIT-20-6-1	20/1	13	14	20/1	LU-90-1	0.5		
	0.3		FIT-20-8-1	20/1	15	16	20/1	FSL-58-8		0.2	
		0.3	AIT-20-5-2	20/1	17	18	20/1	FIT-20-32-1	0.3		
0.3			AIT-20-6-2	20/1	19	20	20/1	FIT-20-32-2		0.3	
	0.3		FIT-20-8-2	20/1	21	22	20/1	FSH-40-28-1			0.2
		0.3	AIT-20-1	20/1	23	24	20/1	FSH-40-28-2	0.2		
0.3			FIT-54-3	20/1	25	26	20/1	FSH-40-9		0.2	
	0.3		LIT-40-20	20/1	27	28	20/1	LIT-20-44			0.3
		0.3	LIT-40-1	20/1	29	30	20/1	AIT-56-1	0.3		
0.3			FIT-50-1	20/1	31	32	30/1	CP-80-1	1.8		
	0.3		AIT-50-7	20/1	33	34	20/1	SP-80-2		0.6	
		0.3	FIT-52-4	20/1	35	36	20/1	SP-90-3			0.6
0.3			AIT-58-9	20/1	37	38	20/1	FIT-12-3 Headworks (2) (3)	0.3		
	0.3		LSHH-40-29	20/1	39	40	20/1	M-12-19 Headworks Sampler		0.6	
		0.3	LSHH-40-10	20/1	41	42	20/1	SPARE			
2.1	2.1	2.1	TOTAL						6.6	5.2	4.8

PANELBOARD SCHEDULES
NTS

(4)

NO.	DESCRIPTION	LAMP	CATALOG NO.	MOUNTING
1	70 LED ENCLOSED AND GASKETED STANCHION MOUNT. COPPER-FREE ALUMINUM HOUSING, POWDER PAINT FINISH, GLASS LENS, LONG AND NARROW LIGHT DISTRIBUTION, AUTO SENSING (120-277V), LISTED FOR CLASS 1, DIVISION 2 LOCATIONS.	70LED NOMINAL 6500 LUMENS 83W	HOLOPHANE LED PETROLUX HPLED-70-35-5K-AS-US-G-L1-40C	1 1/2"C STANCHION
2	S70 LED ENCLOSED AND GASKETED STANCHION MOUNT. COPPER-FREE ALUMINUM HOUSING, POWDER PAINT FINISH, GLASS LENS, LSYMMETRICAL HIGH ANGLE LIGHT DISTRIBUTION, AUTO SENSING (120-277V), LISTED FOR CLASS 1, DIVISION 2 LOCATIONS.	70LED NOMINAL 6500 LUMENS 83W	HOLOPHANE LED PETROLUX HPLED-70-35-5K-AS-US-G-L5H-40C	1 1/2"C STANCHION

LIGHTING SCHEDULE
NTS

David C. Nicholson
CN=David C. Nicholson, OU=Engineering, O=Jacobs Engineering Group Inc., L=Dallas, S=Texas, C=US
2023.07.19 17:26:46-04'00'

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

SHEET KEYNOTES

1. FURNISH AND INSTALL A 3 POLE 20A BREAKER MATCH EXISTING MAKE AND MODEL, INCLUDING BUT NOT LIMITED TO AIC.
2. TAG BREAKER WITH THE APPROPRIATE LOAD(S) AND UPDATE LOCAL PANELBOARD SCHEDULE.
3. FURNISH AND INSTALL TWO (2) SINGLE POLE 20A BREAKERS MATCHING EXISTING MAKE AND MODEL, INCLUDING BUT NOT LIMITED TO AIC.
4. MATCH LUMINAIRES TYPES AND FINISHES TO EXISTING HEADWORKS FACILITY

NO.	DATE	REVISION	DR	CHK	BY	APVD
DSGN	T TWIST	VMCCORVEY		D NICHOLSON	D NICHOLSON	D NICHOLSON

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

ELECTRICAL
PANELBOARD SCHEDULES

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	95-E-601
SHEET	20 of 32

CP-16-3 ◆
UPS

120V
120V UPS
FT
FLOW RATE
FA
LSHH
YS
LEL
FA
AUTO
YS
FA
AUTO
(3)
(3)
SRS
TO SPLITTER BOX

480V
FP-12-1 *
FP-12-2 *
480V

120V
LEL
ASH 12-31
AIT 12-31
AE 12-31
PUMP
AX 12-31

M-12-6
MANUAL BAR SCREEN
G-12-3
G-12-4
G-12-5
G-12-21
G-12-23
G-12-22
M-12-7
CYLINDRICAL BAR SCREEN
TSH 12-8
PROX
ZS 12-9
AS
ESTOP
HS 12-10
M-12-24
VORTEX GRIT SEPARATOR

120V
FIT 12-1
MSC
FE 12-1
RS
LSHH 12-2
LSH 12-2
OF
SA
FROM INFLUENT PUMP STATION (NIS)
FROM PLANT DRAIN PUMP STATION
DEWATERING WASH
LOWER WASH
FC
FV 12-11
FV 12-12
120V
1
REFRIGERATED SAMPLER
M-12-19
NOTE 1
PCV-12-31
W3
W3
FC
FV 12-13
FC
FV 12-23
DR
TO PLANT DRAIN PUMP STATION
FV 12-25
FSL 12-25
FO
W3
GR
TSH 12-27
PI 12-28
PE 12-28
P-12-26
GRIT PUMP
CS
DR
M-12-29
GRIT CYCLONE
GR
OF
DR
DR
M-12-30
GRIT CLASSIFIER
GRIT
2
SCREENINGS DUMPSTER
GRIT DUMPSTER
DR
OA
TO CORROSION CONTROL SYSTEM

1. LOCATE REFRIGERATED SAMPLER SO THAT IT SAMPLES JUST RS AND NOT PDD.

GENERAL SHEET NOTES

1. DEMOLISHED PIPES SHALL BE CAPPED WITH BLIND FLANGES.

⬡ SHEET KEYNOTES

1. EXISTING SAMPLER SHALL BE RELOCATED WITH NEW PLUMBING, POWER AND SIGNAL CABLES.
2. EXISTING SCREENINGS DUMPSTER SHALL BE RELOCATED WITH NEW PLUMBING.

ALABAMA LICENSED
No. 32425
PROFESSIONAL
07-20-2023
CHRISTOPHER LEHMAN HARRIS
ENGINEER

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
		C HARRIS	A PASTRANA	G GRAY			C HARRIS

REVISION

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HEADWORKS - EQUIPMENT FOR DEMOLITOIN, ABANDONMENT, OR RELOCATION

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

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CP-16-3
UPS

120V
120V UPS
FT2
FT
FLOW RATE
FA
480V
FP-12-1
LSHH
LEL
YS
FA
AUTO
480V
FP-12-3 *
ISB
FVR
SS1
OIU
PLC
HOA
HS 12-17A
RST
HS 12-18
E-STOP
HS 12-20
HOA
HS 12-21
HOA
HS 12-22
FWD/REV
HS 12-17B
HORN
XA 12-18
YS 12-21
LI 12-22
LSH 12-22
(3)
(3)
PRESS ZONE FLUSH WASHWATER
LIT 12-22 *
FV 12-22 *
FV 12-21 *
LE 12-22 *
FC
P
120V
SS4
FIT 12-21
MSC
FE 12-21
M
CS
M-12-17 *
DRUM SCREEN
1.0 HP
SCR
15kVA
480-120/240V
1PH
SCREENINGS DUMPSTER
DR
SRS
TO SPLITTER BOX
FP-12-2 *
480V
P
REFRIGERATED SAMPLER
M-12-19
120V
LEL
ASH 12-31
AIT 12-31
AE 12-31
AX 12-31
PUMP
RS
SRS
SA
M-12-6 *
MANUAL BAR SCREEN
G-12-3 *
G-12-4 *
G-12-5 *
G-12-21 *
G-12-23 *
G-12-22 *
OF
S
LSHH 12-2 *
ESTOP
HS 12-10 *
FIT 12-1
MSC
FE 12-1
FROM INFLUENT PUMP STATION (NIS)
FROM PLANT DRAIN PUMP STATION
PDD
M-12-24 *
VORTEX GRIT SEPARATOR
PCV-12-31
W3
DR
FC
FV 12-23 *
TO PLANT DRAIN PUMP STATION
FV 12-25 *
FSL 12-25 *
FO
W3
GR
TSH 12-27 *
PI 12-28 *
PE 12-28 *
P-12-26 *
GRIT PUMP
CS
DR
F
M-12-29 *
GRIT CYCLONE
GR
OF
DR
M-12-30 *
GRIT CLASSIFIER
GRIT
GRIT DUMPSTER
OA
TO CORROSION CONTROL SYSTEM

GENERAL SHEET NOTES

1. ABANDONED EQUIPMENT AND SIGNALS REMOVED FROM THIS PAGE FOR CLARITY.
2. REUSE EXISTING PLC INPUTS AT CP-13-3 FOR SAMPLER AND NEW DRUM SCREEN. EXISTING PLC SIGNALS MUST REMAIN IN PLACE UNTIL NEW SAMPLER LOCATION IS PLUMBED, WIRES PULLED, AND READY FOR RELOCATION. EXISTING SIGNALS FOR BARSCREEN MUST REMAIN IN PLACE UNTIL PIPING AFTER FLOWMETER IS MODIFIED.

SHEET KEYNOTES

1. LOCATE REFRIGERATED SAMPLER SO THAT IT SAMPLES JUST RS AND NOT PDD.
2. DESIGN IS BASED ON ROTOMAT RO9 MICRO STRAINER. CONTRACTOR SHALL BE RESPONSIBLE FOR MODIFICATIONS FOR APPROVED EQUAL EQUIPMENT. ALL I&C MODIFICATIONS ARE TO BE APPROVED BY THE ENGINEER.

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				C HARRIS	

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
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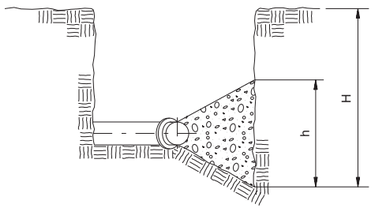
THRUST BLOCK NOTES

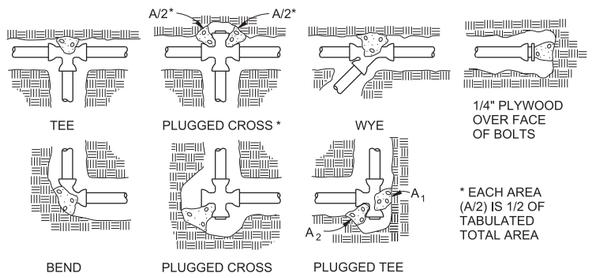
1. KEEP CONCRETE CLEAR OF JOINT AND JOINT ACCESSORIES.
2. CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH.
3. REQUIRED VOLUMES OR BEARING AREAS AT FITTINGS SHALL BE AS INDICATED BELOW, ADJUSTED, IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING PRESSURE(S) OF 2,000 LBS/SQ FT.
4. THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 PSIG AND THE WEIGHT OF CONCRETE = 4050 LBS/CU YD. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES, USE THE FOLLOWING EQUATION: VOLUME = (TEST PRESS./150) x (TABLE VALUE).
5. BEARING AREAS FOR HORIZONTAL BEND THRUST BLOCKS ARE BASED ON TEST PRESSURE OF 150 PSIG AND AN ALLOWABLE SOIL BEARING PRESSURE OF 2000 LBS/SQ FT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, MULTIPLY TABLE VALUES BY THE FACTOR (13.33)(P'/S'), WHERE:
   P'_b = ACTUAL TEST PRESSURE, PSIG
   S'_b = ACTUAL SOIL BEARING PRESSURE, PSF.
6. THRUST BLOCKS FOR VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS SHALL BE THE SAME AS FOR HORIZONTAL BENDS.
7. BEARING AREAS, VOLUMES, AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER THIS STANDARD
8. BEARING AREA OF THRUST BLOCK SHALL NOT BE LESS THAN 1.0 SQ FT.
9. VERTICAL BENDS THAT REQUIRE A THRUST BLOCK VOLUME EXCEEDING 5 CUBIC YARDS REQUIRE SPECIAL BLOCKING DETAILS.
10. CONCRETE COMPRESSIVE STRENGTH SHALL BE 3,000 PSI AND SHALL BE HIGH EARLY.
11. BLOCK HEIGHT (h) SHALL BE EQUAL TO OR LESS THAN 1/2 THE TOTAL DEPTH TO THE BOTTOM OF THE BLOCK (H), BUT NOT LESS THAN THE PIPE DIAMETER.

BEARING AREA OF THRUST BLOCKS IN SQ. FT.
(HORIZONTAL BENDS)

FITTING SIZE	TEE, WYE, PLUG, OR CAP	90° BEND PLUGGED CROSS	TEE PLUGGED RUN		BEND ANGLE		
			A_1	A_2	45°	22 1/2°	11 1/4°
4	1.0	1.4	1.9	1.4	1.0	-	-
6	2.1	3.0	4.3	3.0	1.6	1.0	-
8	3.8	5.3	7.6	5.4	2.9	1.5	1.0
10	5.9	8.4	11.8	8.4	4.6	2.4	1.2
12	8.5	12.0	17.0	12.0	6.6	3.4	1.7
14	11.5	16.3	23.0	16.3	8.9	4.6	2.3
16	15.0	21.3	30.0	21.3	11.6	6.0	3.0
18	19.0	27.0	38.0	27.0	14.6	7.6	3.8
20	23.5	33.3	47.0	33.3	18.1	9.4	4.7
24	34.0	48.0	68.0	48.0	26.2	13.6	6.8
30	52.8	74.4	105.2	74.4	40.5	21.1	10.5
36	76.4	107.4	151.9	107.4	58.6	30.5	15.3
42	104.2	147.0	207.9	147.0	79.8	41.7	20.8

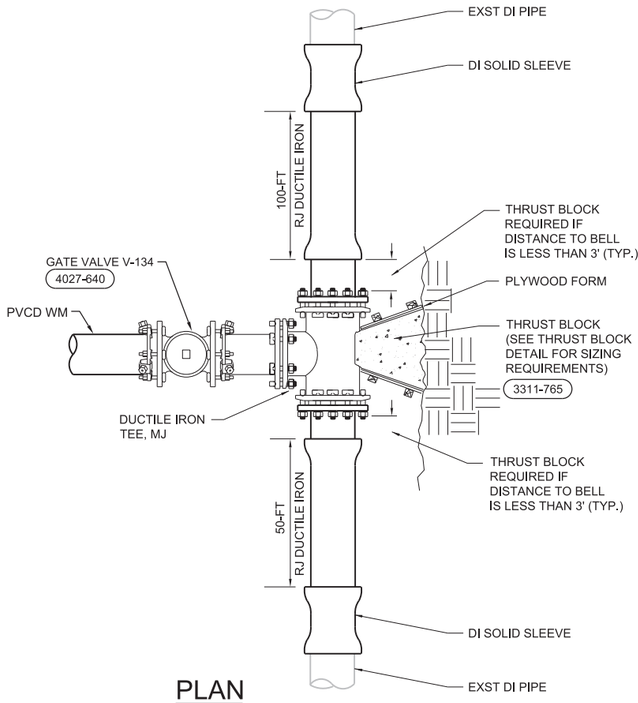


THRUST BLOCK NOTES



* EACH AREA (A/2) IS 1/2 OF TABULATED TOTAL AREA

PLAN
NTS



PLAN
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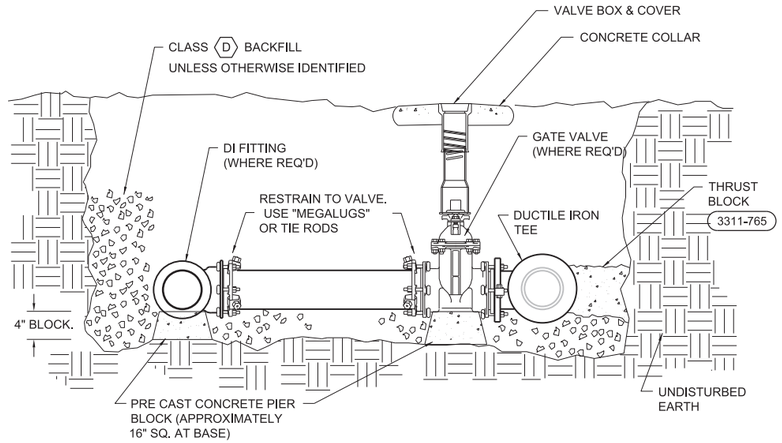

ELEVATION
NTS

NOTES:
1. POLYWRAP ALL FITTINGS AND DUCTILE IRON.
2. FOR CONNECTION AT TANK SITE, SHORTEN LENGTH OF THE SECTION OF 20' DI AS NECESSARY.

THRUST BLOCK NOTES AND DETAILS
NTS

3311-765

STANDARD TIE-IN DETAIL
NTS

3311-775

ALABAMA LICENSED PROFESSIONAL ENGINEER NICHOLAS D. FREEMAN

Nicholas D Freeman
No. 33222
Digitally signed by Nicholas D Freeman
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Date: 2023.07.19 10:12:56 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
REVISION		M LAKEMAN	P HAMERLIK	N FREEMAN	N FREEMAN		N FREEMAN

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
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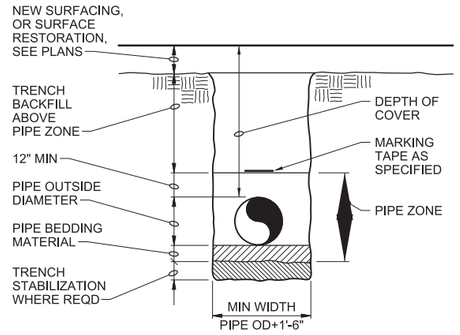


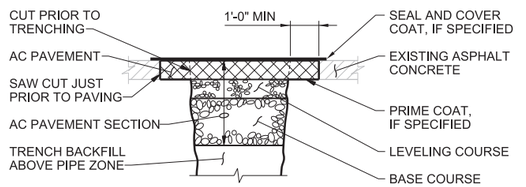
NOTE(S):

1. AS PER GENERAL YARD PIPING AND UTILITY NOTES, AND UNLESS OTHERWISE NOTED, PROVIDE A MIN OF 3 FEET OF COVER FOR ALL NEW PIPING.

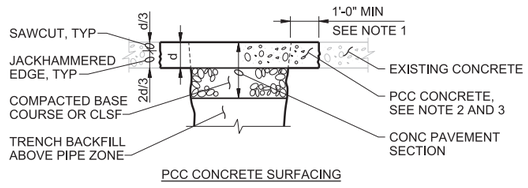
TYPICAL TRENCH

NTS

3123-110



ASPHALT SURFACING



PCC CONCRETE SURFACING

GRAVEL SURFACING

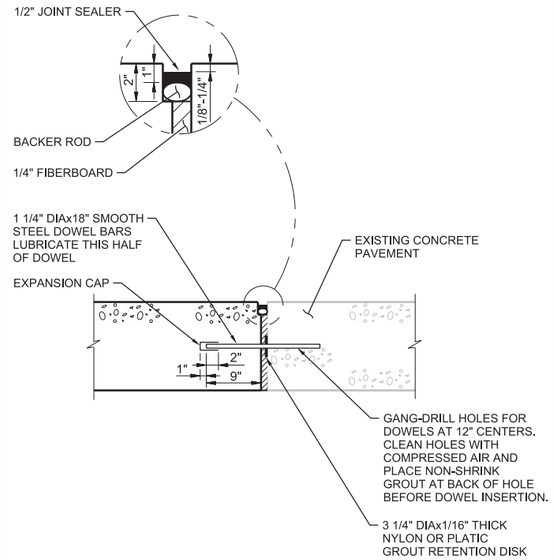
NOTES:

1. IF LOCATION OF TRENCH SAW CUT IS WITHIN 2 FEET OF AN EXISTING JOINT OR EDGE OF CONCRETE, REPLACE ENTIRE CONCRETE TO THE JOINT OR EDGE.
2. CONSTRUCT JOINTS ACROSS NEW CONCRETE TO MATCH EXISTING JOINT TYPES AND LOCATIONS.
3. PCC CONCRETE SHALL MEET ALDOT SPECIFICATIONS.

SURFACE RESTORATION

NTS

3123-115



CONCRETE TO EXISTING CONCRETE CONNECTION

NTS

3213-245

ALABAMA LICENSED PROFESSIONAL ENGINEER NICHOLAS D. FREEMAN NO. 33222

Nicholas D Freeman

Digitally signed by Nicholas D Freeman
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Date: 2023.07.19 10:12:24 -05'00'

NO.	DATE	DSGN	DR	CHK	BY	APVD
REVISION		M LAKEMAN	P HAMMERLIK	N FREEMAN	N FREEMAN	APVD

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
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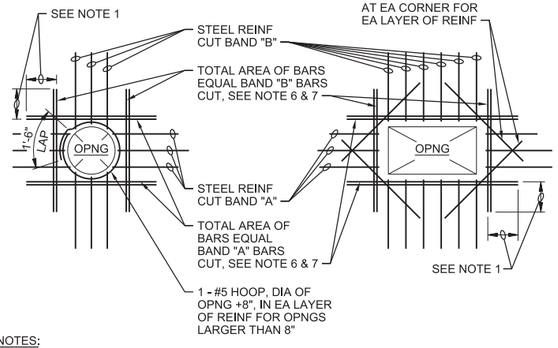


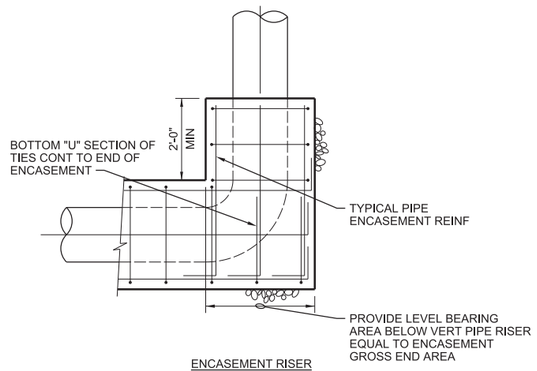
NOTES:

1. PROVIDE MINIMUM LAP, SEE GENERAL STRUCTURAL NOTES.
2. TYPICAL FOR ALL OPENINGS IN CONCRETE WALLS OF BELOW GRADE AND HYDRAULIC STRUCTURES AND ALL STRUCTURAL CONCRETE SLABS UNLESS INDICATED OTHERWISE ON PLANS.
3. DO NOT WELD REINFORCEMENT TO PIPE SLEEVES AND INSERTS.
4. PROVIDE A MINIMUM OF 2 "A" BARS AND 2 "B" BARS EACH SIDE OF OPENING (1 EACH FACE), INCLUDING DOWELS AND CORNER BARS, TYPICAL.
5. FOR OPENINGS LARGER THAN 8'-0", REINFORCE SAME AS FOR 8'-0" OPENINGS.
6. SPACE AT 3 BAR DIAMETERS (OR 3" MINIMUM) ON CENTER. LOCATE HALF OF TOTAL AREA ON EACH SIDE OF OPENING.
7. AT OPENINGS WITHIN 12" OF AN INTERSECTING WALL OR SLAB, PROVIDE ONLY THE EXTRA REINFORCEMENT WHICH WILL FIT, AT THE BAR SPACING IN NOTE 6.

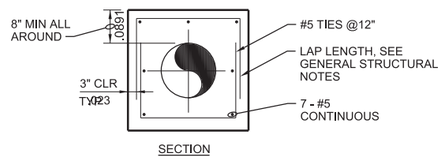
OPENING REINFORCEMENT

NTS

0330-001



ENCASEMENT RISER

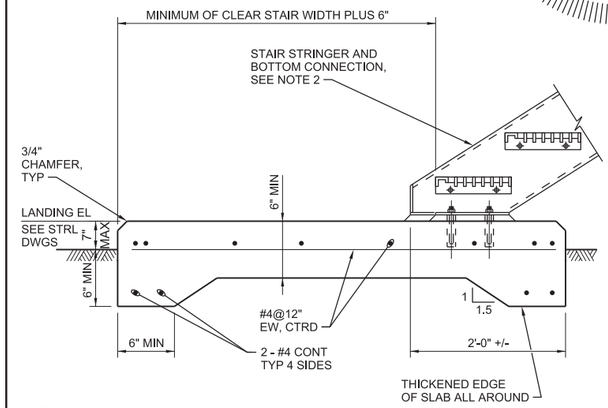


SECTION

PIPE ENCASEMENT

NTS

0330-016



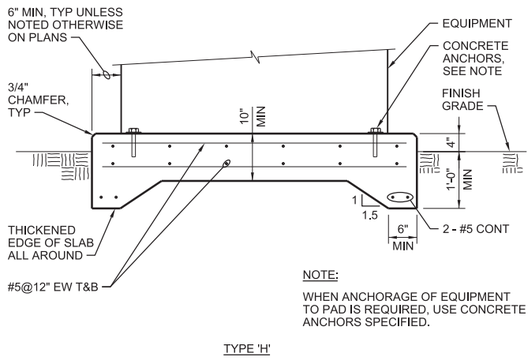
NOTES:

1. LANDING WIDTH MINIMUM OF CLEAR STAIR WIDTH PLUS 1'-0".
2. SEE 0551-001 FOR ALUMINUM STAIR AND 0551-041 FOR STEEL STAIR.

CONCRETE STAIR LANDING

NTS

0330-052



NOTE:

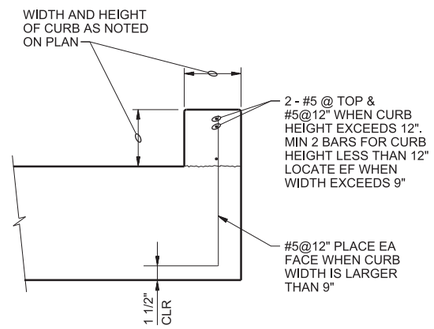
WHEN ANCHORAGE OF EQUIPMENT TO PAD IS REQUIRED, USE CONCRETE ANCHORS SPECIFIED.

TYPE 'H'

CONCRETE EQUIPMENT PAD - TYPE 'H'

NTS

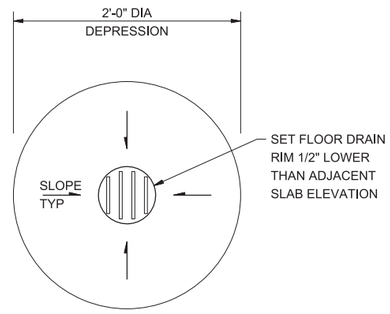
0330-056



CONCRETE CURB

NTS

0330-080



FLOOR DRAIN

NTS

0330-082

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MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
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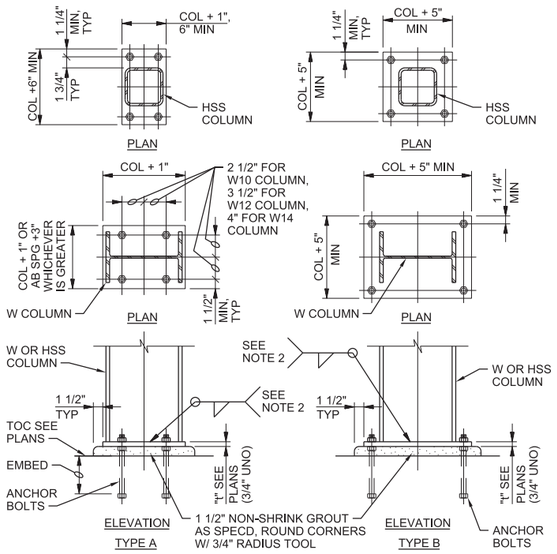


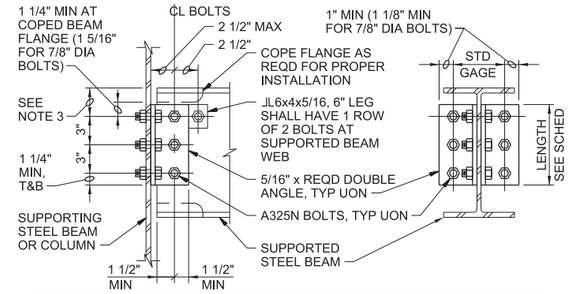
NOTES:

1. UNLESS OTHERWISE NOTED, ANCHOR BOLTS SHALL BE 3/4" DIA x REQUIRED WITH LEVELING NUTS AND 1'-0" MINIMUM EMBED AND BASEPLATES SHALL BE CENTERED ON COLUMN.
2. WELD SIZE SHALL BE DETERMINED BY THE THICKEST MEMBER JOINED; MINIMUM WELD SIZE SHALL BE 3/16" FILLET FOR MATERIAL THICKNESSES UP TO AND INCLUDING 1/2", 1/4" FILLET FOR THICKNESSES OVER 1/2" TO 3/4", AND 5/16" FILLET FOR MATERIAL THICKNESSES OVER 3/4". ALL WELDS SHALL BE SINGLE-PASS WELDS.

COLUMN BASE - STEEL

NTS

0512-001



NOMINAL BEAM DEPTH, INCHES	ROWS OF BOLTS	BOLT DIA, INCHES	DOUBLE ANGLE, LENGTH, INCHES	COMMENTS
36	10	7/8"	2'-6"	ANGLE THK = 3/8"
33	9	7/8"	2'-3"	ANGLE THK = 3/8"
30	8	7/8"	2'-0"	ANGLE THK = 3/8"
27	7	3/4"	1'-8 1/2"	-
24	6	3/4"	1'-5 1/2"	-
21	5	3/4"	1'-2 1/2"	-
16-18	4	3/4"	0'-11 1/2"	-
12-15	3	3/4"	0'-8 1/2"	-
8-10	2	3/4"	0'-5 1/2"	-
6	1	3/4"	0'-3"	JL 6"x4"x5/16"
4	1	3/4"	0'-2 1/2"	JL 6"x4"x5/16"

NOTES:

1. ALL BEAM FRAMING CONNECTIONS SHALL CONFORM TO THIS DETAIL UNLESS SPECIFICALLY NOTED OTHERWISE OR APPROVED IN WRITING BY THE ENGINEER.
2. PROVIDE ADDITIONAL 1 1/2" LENGTH TO DOUBLE ANGLE FOR STAGGERED BOLT CONNECTIONS WHEN REQUIRED OR USED.
3. DIMENSION SHALL BE 3" UNLESS OTHERWISE REQUIRED FOR PROPER FABRICATION.

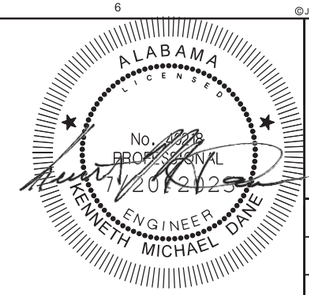
TYPICAL BEAM CONNECTION - STEEL

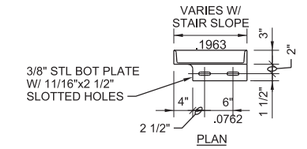
NTS

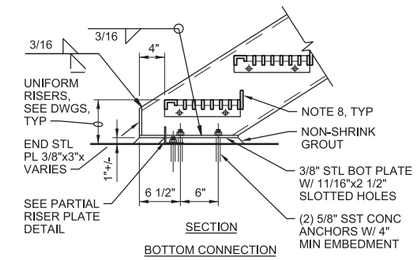
0512-020

NOTES:

1. PROVIDE PROTECTION FOR DISSIMILAR METALS AND FOR STEEL IN CONTACT WITH CONCRETE PER SPECIFICATIONS.
2. AMERICAN STANDARD C12x20.7 STEEL STRINGERS TYPICAL EXCEPT WHERE OTHERWISE NOTED ON PLANS.
3. GALVANIZED STEEL GRATING TREADS UNLESS OTHERWISE NOTED ON PLANS.
4. STAIR RAILING NOT SHOWN.
5. STAIR MANUFACTURER TO COORDINATE BOLTED TREADS AND RAILING CONNECTIONS.
6. FIELD VERIFY DIMENSIONS AND ELEVATIONS PRIOR TO FABRICATION.
7. HOT DIP GALVANIZE ALL MEMBERS AND FASTENERS AFTER FABRICATION.
8. FOR RISER PLATE SEE PARTIAL RISER PLATE DETAIL UNLESS NOTED OTHERWISE, CLEARANCE BETWEEN TOP OF RISER PLATE AND BOTTOM OF TREAD TO BE 3 3/4" MAXIMUM. FOR STAIRS WITH PICKET RAILING EXTEND RISER PLATE PER FULL RISER PLATE DETAIL.





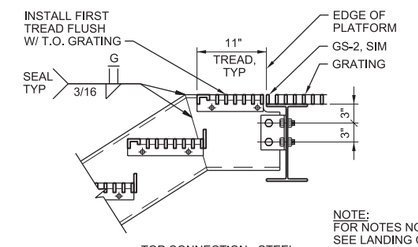


DETAIL 1 OF 2

STAIR DETAILS - STEEL

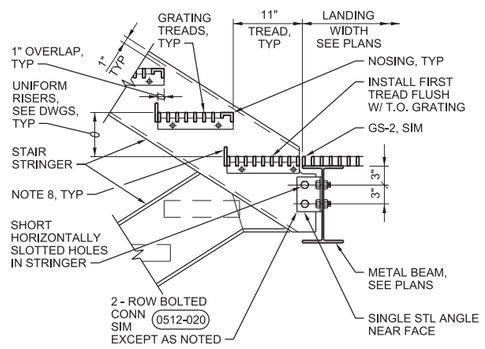
NTS

0551-041



NOTE:
FOR NOTES NOT SHOWN SEE LANDING CONNECTION.

TOP CONNECTION - STEEL



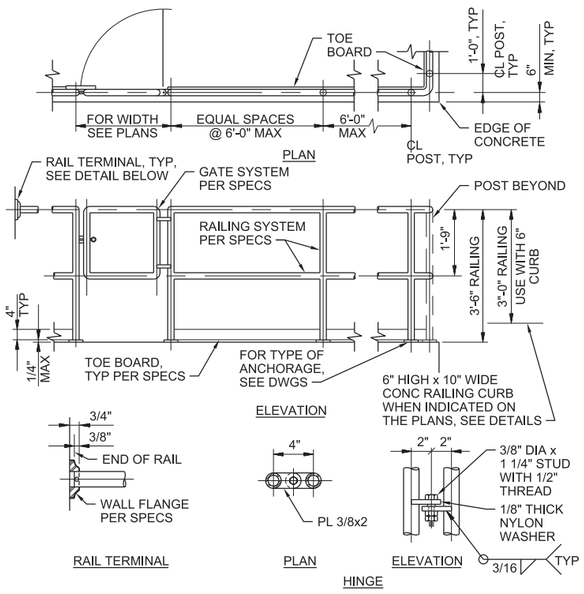
LANDING CONNECTION - STEEL

DETAIL 2 OF 2

STAIR DETAILS - STEEL

NTS

0551-041



NOTES:

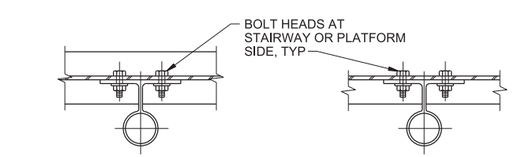
1. FASTEN RAIL TO WALL FLANGE PER MANUFACTURER'S RECOMMENDATIONS.
2. WALL FLANGE TO BE MOUNTED TO WALL WITH (2) 3/8" DIA SST WEDGE ANCHORS.
3. AT CONTRACTOR'S OPTION FABRICATE HINGES OR PROVIDE OTHER HINGES PER SPECIFICATIONS. ANODIZE FINISH AFTER ALL WELDING PER SPECIFICATIONS.

DETAIL 1 OF 4

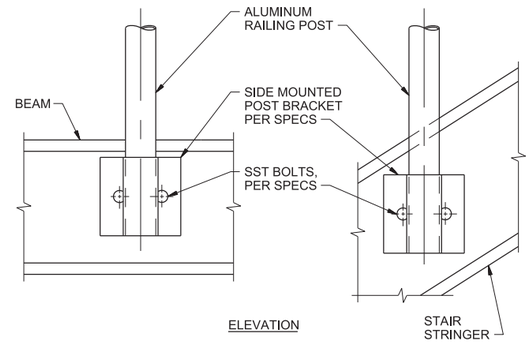
RAILING - 2 RAIL - ALUMINUM

NTS

0552-001



PLAN



TYPE 'D'

NOTE:
PROVIDE PROTECTION FOR DISSIMILAR METALS PER SPECIFICATIONS.

DETAIL 2 OF 4

RAILING
POST ANCHORAGE TYPE 'D' - ALUMINUM

NTS

0552-001

NO.	DATE	REVISION	DR	CHK	APVD	BY	APVD
			E ALMANASEER	A KONIOR	G PETTY		K DANE

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

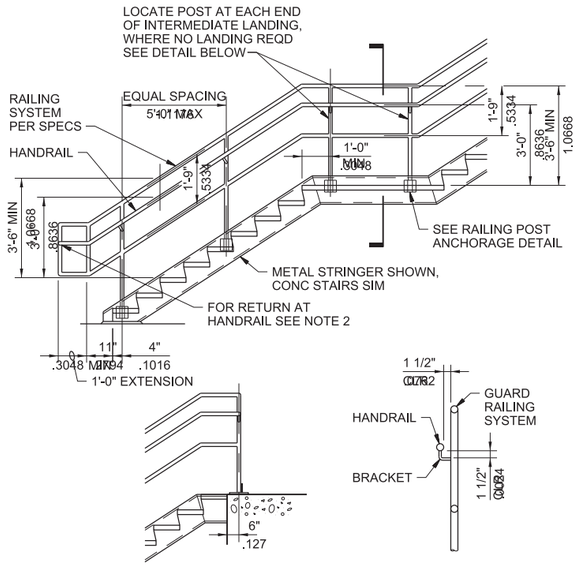
Jacobs

STRUCTURAL
STANDARD DETAILS

BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	99-S-502
SHEET	26 of 32



RAILING DETAIL WITHOUT LANDING

RAILING SECTION

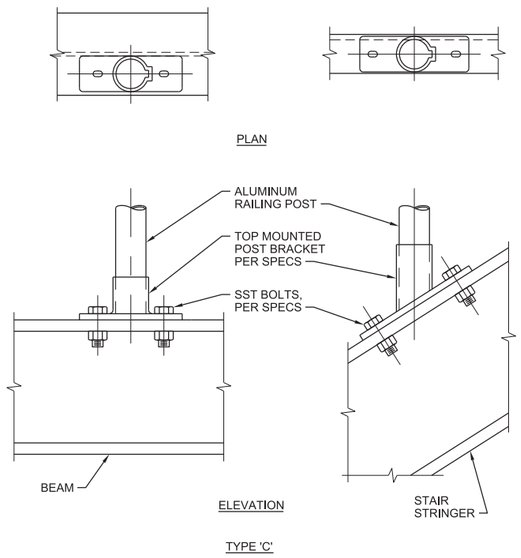
NOTES:
1. PROVIDE TOE BOARD AT LANDING WHERE REQUIRED.
2. RETURN ENDS OF HANDRAIL TO GUARD AT BOTH ENDS.

RAILING W/ EXTENSION - 2 RAIL STAIR - ALUMINUM (IBC)

NTS

DETAIL 3 OF 4

0552-001



TYPE 'C'

NOTE:

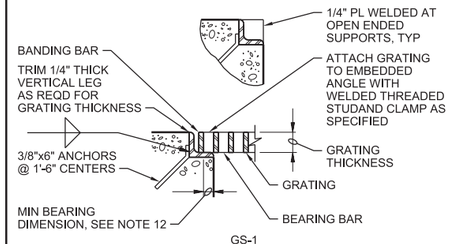
PROVIDE PROTECTION FOR DISSIMILAR METALS PER SPECIFICATIONS.

RAILING POST ANCHORAGE TYPE 'C' - ALUMINUM

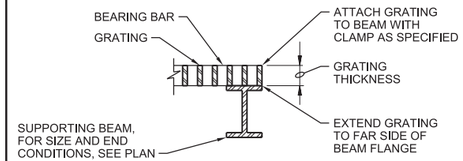
NTS

DETAIL 4 OF 4

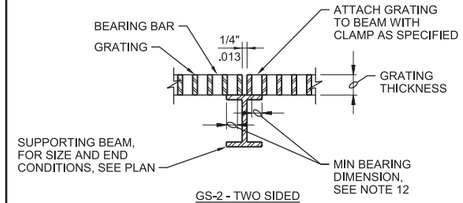
0552-001



GS-1



GS-2 - ONE SIDED



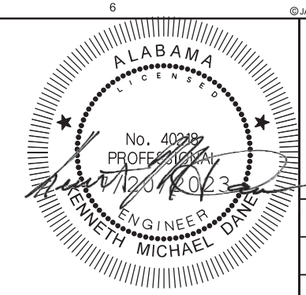
GS-2 - TWO SIDED

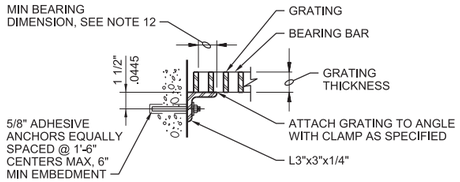
STANDARD GRATING

NTS

DETAIL 1 OF 4

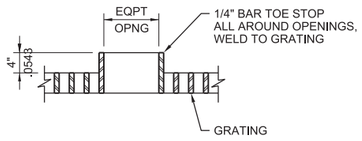
0553-001





NOTES:
1. USE GS-3 ONLY FOR LIGHT DUTY GRATING, TYPE 'A'.
2. INSTALL ANCHORS MAXIMUM 4" FROM EACH END.
3. WHEN ANCHOR IS WITHIN 4" OF A CONCRETE EDGE, UTILIZE MANUFACTURER'S LOW-TORQUE INSTALLATION PROCEDURES.

GS-3



EQUIPMENT OPENINGS

STANDARD GRATING

NTS

DETAIL 2 OF 4

0553-001

GENERAL NOTES:

1. GRATING SHALL BE LIGHT DUTY GRATING UNLESS OTHERWISE NOTED ON DRAWINGS.
2. GRATING SPAN IS INDICATED BY ⟷, SEE PLAN.
3. INDIVIDUAL GRATING SECTIONS SHALL NOT EXCEED 3'-0" IN WIDTH OR WEIGH MORE THAN 150 POUNDS, UNLESS INDICATED OTHERWISE, FOR TYPES 'A' & 'B' GRATING. TYPE 'C' GRATING SHALL HAVE A MINIMUM WIDTH OF 2'-0" REGARDLESS OF WEIGHT.
4. SHOP DRAWINGS BASED ON FIELD DIMENSIONS SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO FABRICATION.
5. MATERIAL FOR SUPPORTS OF STEEL AND ALUMINUM GRATING TO BE SAME AS GRATING, EXCEPT METAL SUPPORTS THAT ARE TO BE EMBEDDED IN CONCRETE SHALL BE TYPE 316 STAINLESS STEEL.
6. UNLESS NOTED OTHERWISE ON PLANS, GRATING THICKNESS SHALL BE AS TABULATED IN "GRATING THICKNESS TABLE" FOR APPLICABLE GRATING TYPE.
7. FOR SERRATED BEARING BARS, INCREASE GRATING THICKNESSES SHOWN IN TABLES BY 1/4".
8. BEARING BAR THICKNESS FOR GRATING TO BE 3/16" MINIMUM. SEE SPECIFICATIONS FOR SPACING OF BEARING AND CROSS BARS.
9. BAND ALL EDGES. MATCH DEPTH OF BEARING BAR.
10. TYPE OF MATERIAL USED SHALL BE AS SHOWN ON PLANS OR AS SPECIFIED. THIS STANDARD DETAIL INCLUDES 2 TYPES, ALTHOUGH BOTH MAY NOT BE INCLUDED IN PROJECT.
11. THE HORIZONTAL CLEARANCE BETWEEN THE GRATING AND GRATING SUPPORTS SHALL NOT BE LESS THAN 1/4" NOR GREATER THAN 1/2" AND AS SPECIFIED.
12. MINIMUM BEARING HORIZONTAL DIMENSION = 1" FOR GRATING DEPTH 2 1/4" OR LESS. MINIMUM BEARING HORIZONTAL DIMENSION = 2" FOR GRATING DEPTH GREATER THAN 2 1/4"

STANDARD GRATING

NTS

DETAIL 3 OF 4

0553-001

LIGHT DUTY GRATING
TYPE 'A'
(100 PSF)

GRATING THICKNESS TABLE

MAXIMUM SPAN	STEEL	ALUMINUM
3'-6"	1"	1 1/4"
4'-0"	1"	1 1/2"
4'-6"	1"	1 3/4"
5'-0"	1 1/4"	1 3/4"
5'-6"	1 1/4"	2"
6'-0"	1 1/2"	2 1/4"
6'-6"	1 1/2"	2 1/4"
7'-0"	1 3/4"	2 1/2"

MEDIUM DUTY GRATING
TYPE 'B'
(500 PSF)

GRATING THICKNESS TABLE

MAXIMUM SPAN	STEEL	ALUMINUM
< 2'-0"	1"	1"
2'-6"	1"	1 1/4"
3'-0"	1 1/4"	1 1/2"
3'-6"	1 1/4"	1 3/4"
4'-0"	1 1/2"	2"
4'-6"	1 3/4"	2 1/4"
5'-0"	1 3/4"	2 1/2"
5'-6"	2"	DO NOT USE ALUMINUM GRATING
6'-0"	2 1/4"	
6'-6"	2 1/2"	

HEAVY DUTY GRATING
TYPE 'C'
(H 20 WHEEL LOAD)

GRATING THICKNESS TABLE

MAXIMUM SPAN	STEEL	ALUMINUM
1'-0"	2"x3/16"	DO NOT USE ALUMINUM GRATING
1'-8"	2 1/2"x1/4"	
2'-0"	2 1/2"x3/8" OR 3"x1/4"	
2'-6"	3"x3/8" OR 4"x1/4"	
3'-3"	3 1/2"x3/8"	
4'-0"	4"x3/8"	
5'-0"	4 1/2"x3/8"	

STANDARD GRATING

NTS

DETAIL 4 OF 4

0553-001

NO.	DATE	REVISION	BY	APVD
DSGN	E ALMANASEER	DR A KONIOR / CHK G PETTY	APVD	K DANE

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

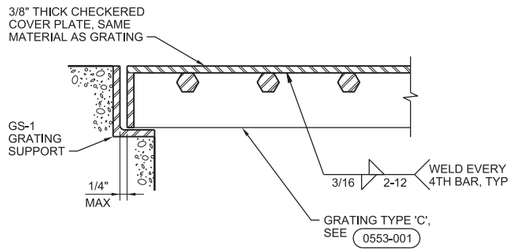
STRUCTURAL
STANDARD DETAILS

BID DOCUMENTS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	99-S-503
SHEET	27 of 32



COVERED GRATING

NTS

0553-002

ALABAMA LICENSED No. 40218 PROFESSIONAL ENGINEER KENNETH MICHAEL DANE

7/20/2023

NO.	DATE	REVISION	DR	CHK	APVD	BY	APVD
DSGN	E ALMANASEER		A KONIOR	G PETTY			K DANE

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

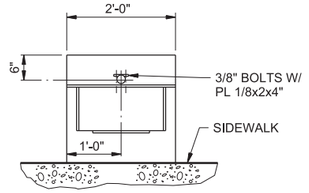
Jacobs

STRUCTURAL
STANDARD DETAILS

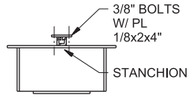
BID DOCUMENTS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

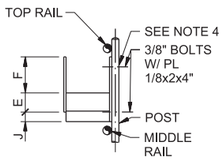
DATE	JULY 2023
PROJ	D3571200
DWG	99-S-504
SHEET	28 of 32



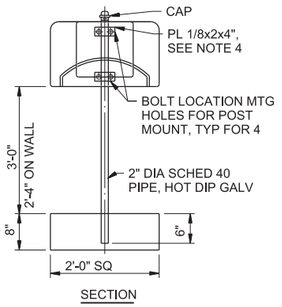
PLAN-POST MOUNT



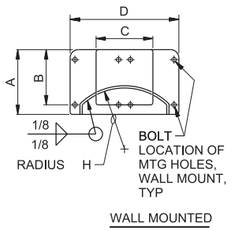
STANCHION MOUNTED



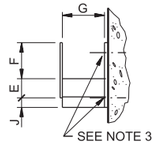
HANDRAIL POST MOUNTED



SECTION



WALL MOUNTED



DIMENSION IN INCHES

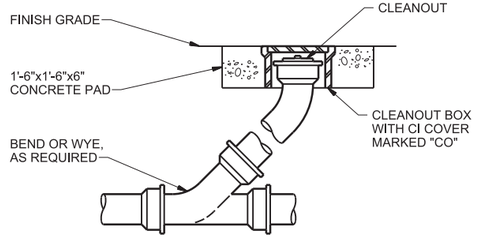
RACK TYPE	A	B	C	D	E	F	G	H	J
TYPE A-3/4" & 1" HOSE	10-1/2	9	9	18	3	6	7-1/2	9-3/4	1-1/2
TYPE B-1 1/2" HOSE	14	12	12	24	4	8	10	13	2

NOTES:

1. INTERIOR UNITS SHALL BE FABRICATED FROM 1/8" A-36 STEEL PLATE AND ENTIRE UNIT SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.
2. EXTERIOR UNITS SHALL BE FABRICATED FROM 3/16" 6061-T6 ALUMINUM ALLOY PLATE.
3. ATTACH TO CONCRETE WALL WITH (4) - 3/8" STAINLESS STEEL STUD TYPE WEDGE ANCHORS.
4. ATTACH TO VERTICAL HANDRAIL OR INDIVIDUAL POST WITH PLATES AND (4)- 3/8" STAINLESS STEEL BOLTS.
5. ATTACH TO STEEL COLUMN WITH (4)- 3/8" ROUND HEAD BOLTS, ONE IN EACH CORNER. INSERT DOUBLE SPACER NUTS BETWEEN COLUMN AND HOSE RACK.

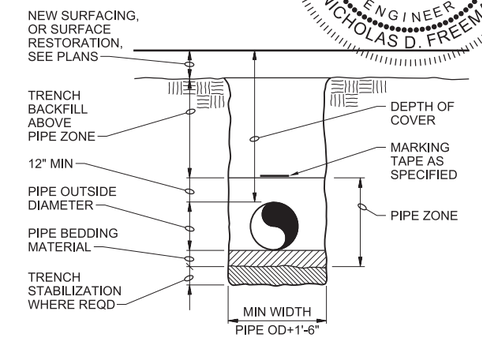
HOSE RACKS
NTS

2210-720



EXTERIOR CLEANOUTS
NTS

2240-180

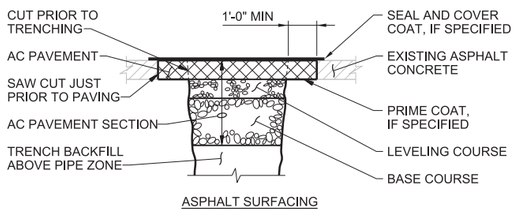


NOTE(S):

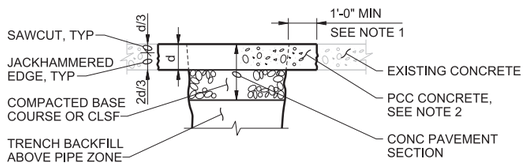
1. AS PER GENERAL YARD PIPING AND UTILITY NOTES, AND UNLESS OTHERWISE NOTED, PROVIDE A MIN OF 3 FEET OF COVER FOR ALL NEW PIPING.

TYPICAL TRENCH
NTS

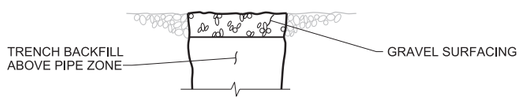
3123-110



ASPHALT SURFACING



PCC CONCRETE SURFACING



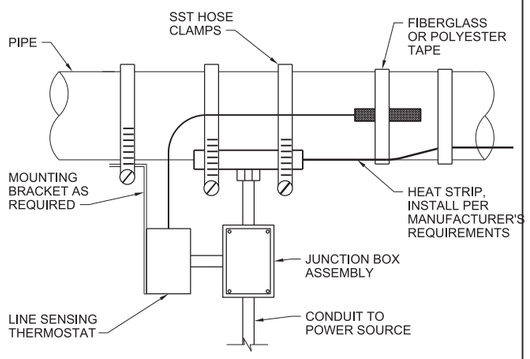
GRAVEL SURFACING

NOTES:

1. IF LOCATION OF TRENCH SAW CUT IS WITHIN 2 FEET OF AN EXISTING JOINT OR EDGE OF CONCRETE, REPLACE ENTIRE CONCRETE TO THE JOINT OR EDGE.
2. CONSTRUCT JOINTS ACROSS NEW CONCRETE TO MATCH EXISTING JOINT TYPES AND LOCATIONS.

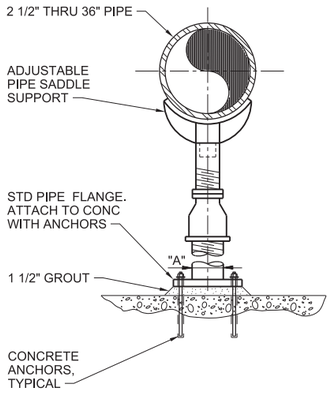
SURFACE RESTORATION
NTS

3123-115



HEAT TRACE CONNECTION
NTS

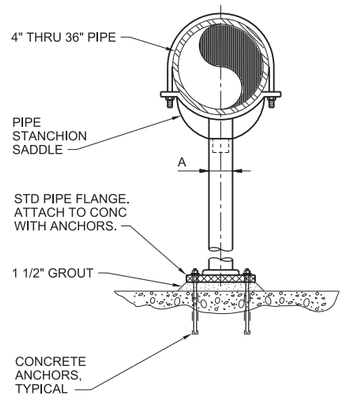
4005-001



DIMENSION TABLE	
PIPE SIZE	"A" MINIMUM NOMINAL PIPE SIZE
2-1/2"	2-1/2"
3"	2-1/2"
4"	3"
6"	3"
8"	3"
10"	3"
12"	3"
14"	4"
16"	4"
20"	6"
24"	6"
36"	6"

PIPE SUPPORT
NTS

4005-500



DIMENSION TABLE	
PIPE SIZE	A
2-1/2"	2-1/2"
3"	2-1/2"
4"	3"
6"	3"
8"	3"
10"	3"
12"	3"
14"	3"
16"	3"
20"	4"
24"	4"
30"	4"
36"	4"

PIPE SUPPORT
NTS

4005-501

ALABAMA LICENSED PROFESSIONAL ENGINEER NICHOLAS D. FREEMAN

Nicholas D Freeman No. 33222

Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
Date: 2023.07.19 10:12:54 -05'00'

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
		M LAKEMAN	P HAMMERLIK	N FREEMAN	N FREEMAN	REVISION	

Jacobs

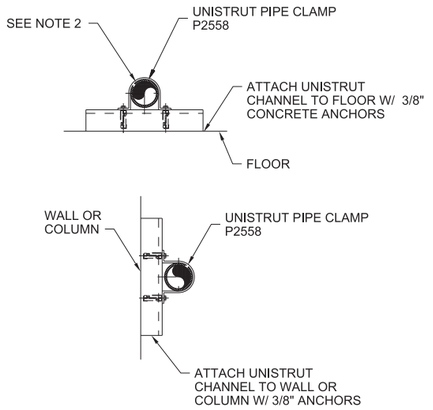
MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

PROCESS MECHANICAL
STANDARD DETAILS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	99-D-501
SHEET	29 of 32

BID DOCUMENTS



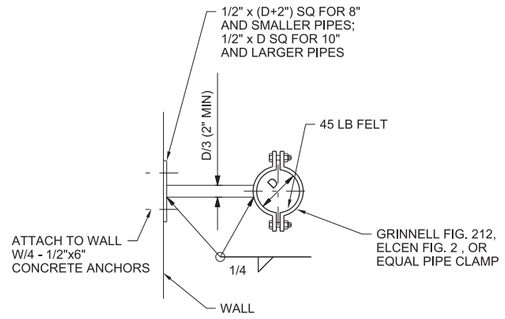
NOTES:

1. FOR MATERIALS OF CONSTRUCTION SEE SPECIFICATIONS SECTION 40 05 15.
2. FOR PVC PIPE USE UNISTRUT P2600 UNICUSHION INSTALLED BY THE MECHANICAL CONTRACTOR.
3. TIGHTEN CLAMP SNUG TO PIPE.

PIPE SUPPORT

NTS

4005-502



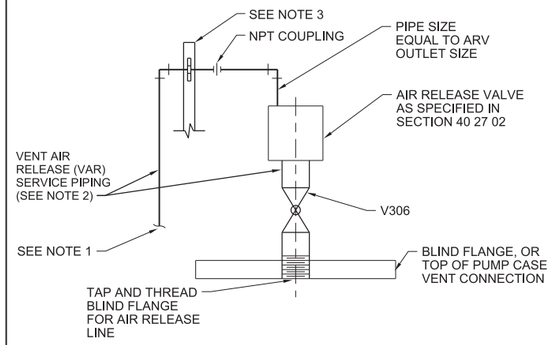
NOTES:

1. HOT DIP GALVANIZE AFTER FABRICATION.

TYPE A PIPE SWAY BRACE

NTS

4005-710X



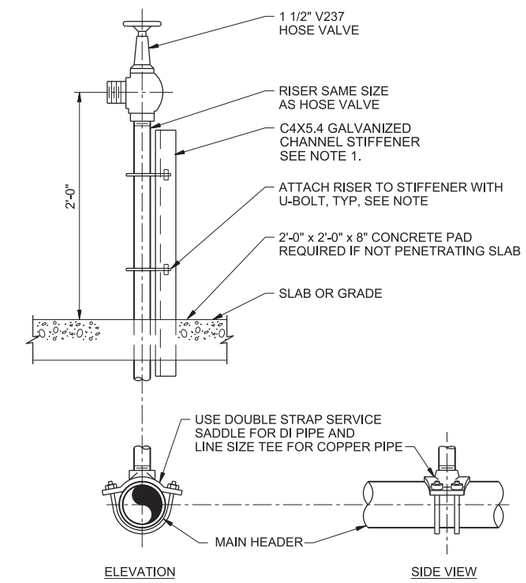
NOTES:

1. ROUTE VENT TO FLOOR DRAIN/TRENCH DRAIN.
2. ARV RELEASE VALVE TO BE RATED FOR 150 PSI OPERATING PRESSURE
3. SECURE PIPING AGAINST VIBRATION BY FASTENING TO STANCHION SUPPORT (4005-495)

AIR RELEASE VALVE ASSEMBLY

NTS

4027-064



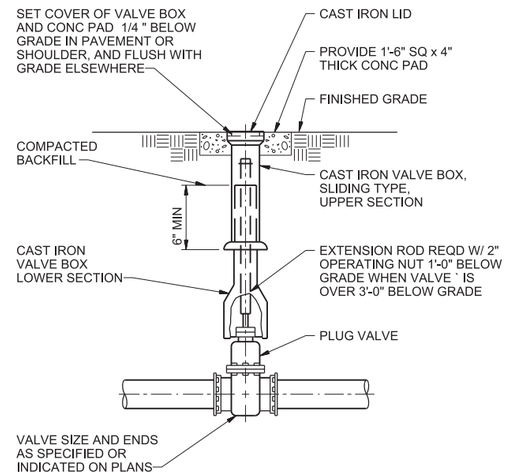
NOTES:

1. CHANNEL STIFFENER AND RISER ATTACHMENT HARDWARE SHALL BE (A: GALVANIZED STEEL) (B: STAINLESS STEEL) (C: AS SPECIFIED).

EXTERIOR HOSE VALVE

NTS

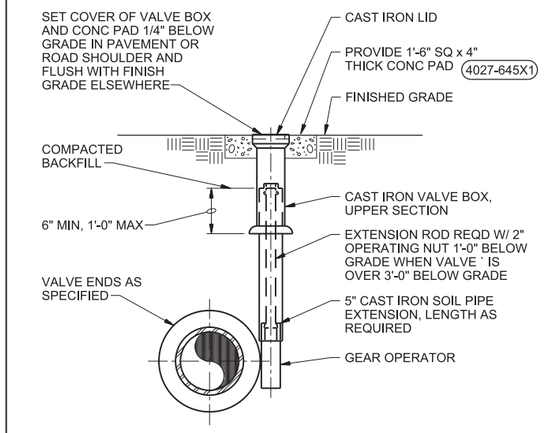
4027-150



BURIED PLUG VALVE BOX

NTS

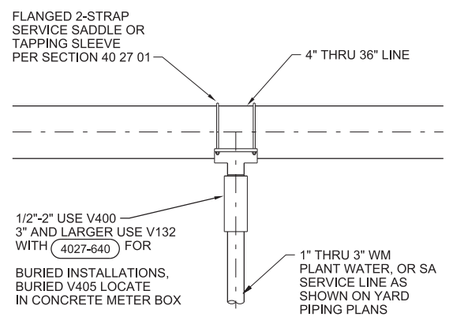
4027-640



BURIED BUTTERFLY AND PLUG VALVE BOX

NTS

4027-641



PLAN

SERVICE TAP

NTS

4027-643

Nicholas D Freeman

Digitally signed by Nicholas D Freeman
DN: cn=Nicholas D Freeman, c=US, email=nicholas.freeman@jacobs.com
Date: 2023.07.19 10:32:52 -05'00'

ALABAMA LICENSED PROFESSIONAL ENGINEER NICHOLAS D. FREEMAN No. 33222

NO.	DATE	DSGN	DR	CHK	BY	APVD
REVISION		M LAKEMAN	P HAMMERLIK	N FREEMAN		N FREEMAN
						APVD

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

PROCESS MECHANICAL

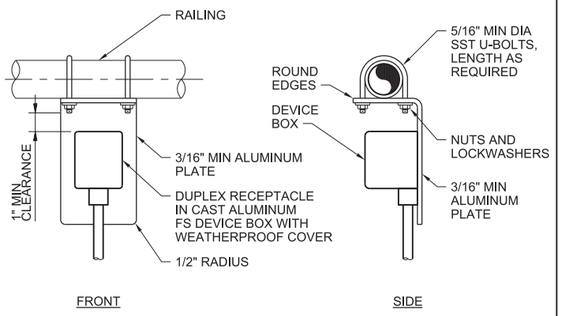
STANDARD DETAILS

BID DOCUMENTS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

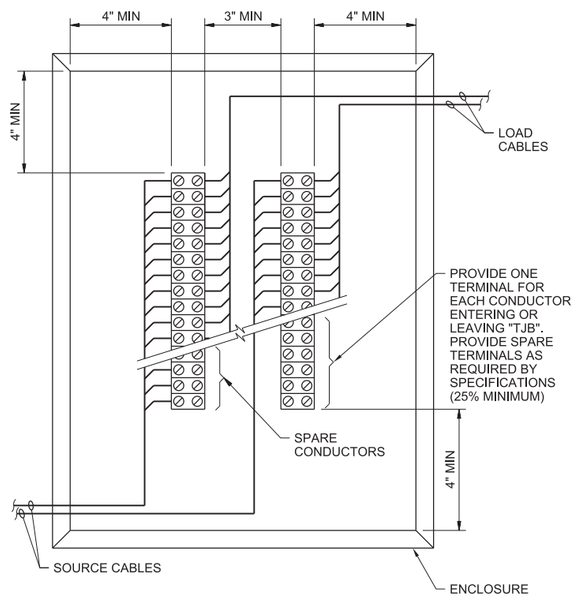
DATE	JULY 2023
PROJ	D3571200
DWG	99-D-502
SHEET	30 of 32



NOTES:
1. THIS DETAIL SHALL BE USED FOR MOUNTING OF ALL WIRING DEVICES AND JUNCTION BOXES 4 INCHES SQUARE AND SMALLER ON RAILING WHETHER DETAIL IS CALLED OUT OR NOT.
2. ALL HARDWARE TO BE STAINLESS STEEL. USE WASHER AND SPLIT LOCKWASHERS WITH ALL NUTS.
3. ALL EDGES AND THE ENDS OF ALL U-BOLTS WHICH HAVE BEEN CUT SHALL BE FILED SMOOTH.
4. COORDINATE EQUIPMENT LOAD WITH RAILING MANUFACTURER.

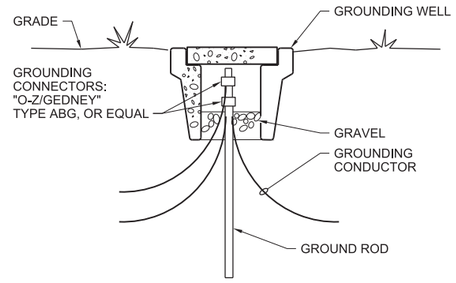
DEVICE MOUNTING, ON RAILING
NTS

2605-006B



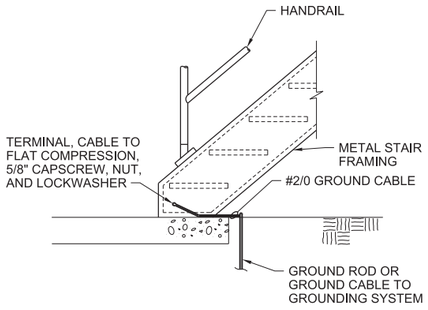
TERMINAL JUNCTION BOX (TJB)
NTS

2605-102



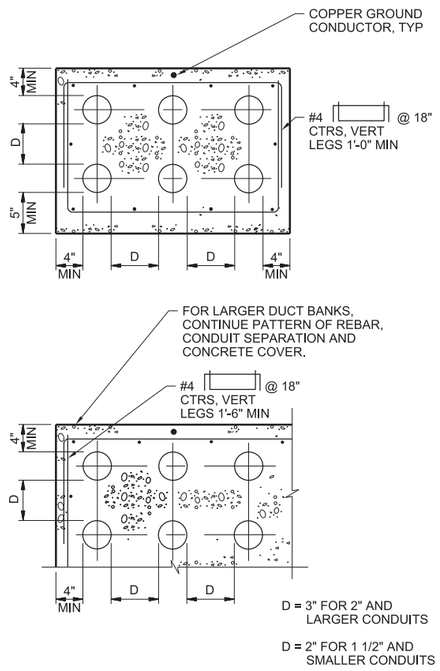
GROUND TEST WELL
NTS

2605-202



GENERAL STAIRWAY GROUNDING
NTS

2605-207



DUCT BANK
NTS

2605-400c

David C. Nicholson
CN=David C. Nicholson, OU=Engineering, O=Jacobs Engineering Group Inc., L=Dallas, S=Texas, C=US
2023.07.19

LICENSED
No. 28944
PROFESSIONAL
DAVID CARL NICHOLSON

NO.	DSGN	DATE	REVISION	BY	APVD
	T TWIST		DR	VMCCORVEY	CHK	D NICHOLSON	APVD	D NICHOLSON

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

ELECTRICAL
STANDARD DETAILS

BID DOCUMENTS

VERIFY SCALE
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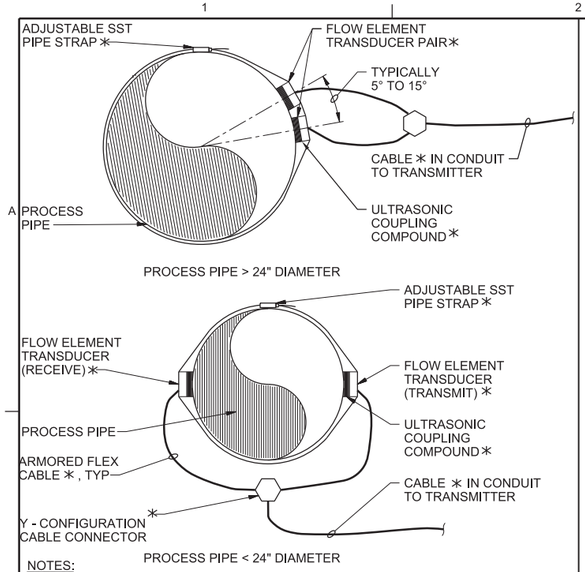
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	95-E-601
SHEET	31 of 32



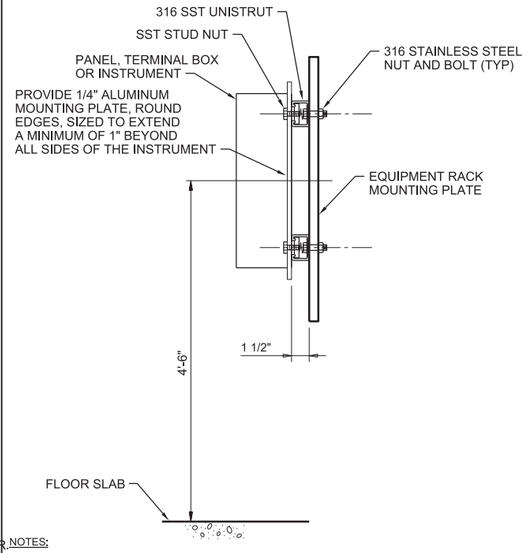
NOTES:

1. COMPONENTS DESIGNATED BY ✳ ARE SUPPLIED BY INSTRUMENT MANUFACTURER.
2. INSTALL TRANSDUCERS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

DOPPER ULTRASONIC FLOW ELEMENT INSTALLATION

NTS

4091-209



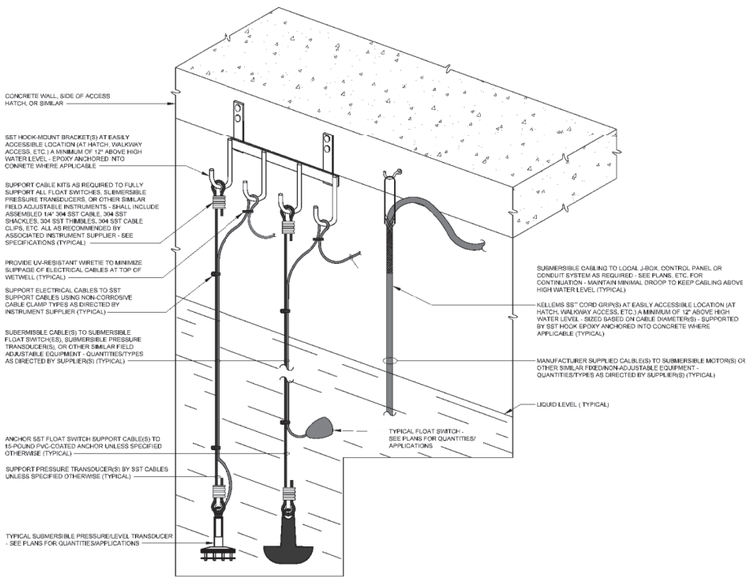
NOTES:

1. REFER TO AREA CLASSIFICATION TABLES FOR ANCHOR MATERIAL REQUIREMENTS.

EQUIPMENT RACK MOUNTED PANEL, TERMINAL BOX OR INSTRUMENT INSTALLATION

NTS

4091-388PD



SUBMERSIBLE CABLE SUPPORT

NTS

4091-915

ALABAMA LICENSED
No. 32425
PROFESSIONAL
01-20-2023
CHRISTOPHER LEHMAN HARRIS
ENGINEER

NO.	DATE	DSGN	DR	CHK	BY	REVISION	APVD	BY	APVD
		C HARRIS	A PASTRANA	G GRAY				C HARRIS	

BID DOCUMENTS

MILLEY'S CREEK WPCP SCREEN REPLACEMENT
WATER WORKS AND SANITARY SEWER BOARD
CITY OF MONTGOMERY, ALABAMA

Jacobs

INSTRUMENTATION AND CONTROL

STANDARD DETAILS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2023
PROJ	D3571200
DWG	99-N-501
SHEET	32 of 32