Department of Management Services
Purchasing Division
241 West South Street
Kalamazoo, MI 49007-4796
Phone: 269.337.8020
Fax: 269.337.8500
www.kalamazoocity.org
purchasing@kalamazoocity.org

MANDATORY PRE-BID MEETING/SITE INSPECTION –
Wednesday, March 9, 2022 @ 10:00AM Local Time
LOCATION: 1415 Harrison St., Kalamazoo, MI, Conference Room A

INVITATION FOR BIDS (IFB)
The City of Kalamazoo, Michigan is soliciting sealed Bids for:

Project Name: Contract 76 B.1 – Biological Foul Air Mitigation System – Construction – Rebid

Bid Reference #: 91359-003.0

IFB ISSUE DATE: February 24, 2022

BID DUE/OPENING DATE: March 29, 2022 @ 3:00 p.m. Local Time
Facsimile Bids Will Not Be Accepted.

MAILING ADDRESS & INSTRUCTIONS
Mail to:
Purchasing Division
241 W. South Street
Kalamazoo, MI 49007

Questions about this IFB should be directed to:
Department Contact: **Ryan Stoughton, PE,**
Assistant City Engineer at
stoughtonr@kalamazoocity.org

Include on the Envelope the Project Name and Bid Reference Number. All Envelopes Must Be Sealed.

You are invited to submit a Bid for this project. Specifications, terms, conditions and instructions for submitting Bids are contained herein. This Invitation for Bids with all pages, documents and attachments contained herein, or subsequently added to and made a part hereof, submitted as a fully and properly executed Bid shall constitute the Contract between the City of Kalamazoo and the successful bidder when approved and accepted on behalf of the City by an authorized official or agent of the City. Please review the bid document as soon as possible and note the **DEADLINE FOR QUESTIONS** in the Instructions to Bidders.

All bidders shall complete and return the Bid and Award page(s) and submit all information requested herein in order for a bid to be responsive. The bid document shall be returned in its entirety, in a properly identified and sealed envelope to the Purchasing Division at the above address. **BIDS MUST BE RECEIVED BEFORE THE DUE DATE - LATE BIDS WILL NOT BE CONSIDERED.** The City reserves the right to postpone the bid opening for its own convenience.

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City of Kalamazoo – Invitation for Bids **Bid Reference #: 91359-003.0**
Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

STATEMENT OF NO BID

NOTE: If you <u>DO NOT</u> intend to bid on this commodity or service, please complete and return this form immediately. Your response will assist us in evaluating all responses for this important project and to improve our bid solicitation process.

The Purchasing Division of the City of Kalamazoo wishes to keep its bidders list file up-to-date. If, for any reason you cannot supply the commodity/service noted in this bid solicitation, this form must be completed and returned to remain on the particular bid list for future projects of this type.

If you do not respond to this inquiry within the time set for the bid opening date and time noted, we will assume that you can no longer supply this commodity/service, and your name will be removed from this bid list.

_____ Specifications too "tight", i.e. geared toward one brand or manufacturer only (explain below).

_____ Specifications are unclear (explain below).

_____ We are unable to meet specifications.

_____ Insufficient time to respond to the Invitation for Bid.

_____ Our schedule would not permit us to perform.

_____ We are unable to meet bond requirements.

_____ We are unable to meet insurance requirements.

_____ We do not offer this product or service.

_____ Remove us from your bidders list for this commodity or service.

_____ Other (specify below).

REMARKS: _____

_____

SIGNED: _____ NAME: _____
(Type or Print)

TITLE: _____ DATE: _____

FIRM NAME: _____
(if any)

ADDRESS: _____
(Street address) (City) (State) (Zip)

PHONE: _____ FAX: _____

EMAIL: _____

SECTION I
INSTRUCTIONS TO BIDDERS

1. **EXAMINATION OF BID DOCUMENT**-Before submitting a bid, bidders shall carefully examine the specifications and shall fully inform themselves as to all existing conditions and limitations. The bidder shall indicate in the bid the sum to cover the cost of all items included on the bid form.

2. **PREPARATION OF BID**-The bid shall be legibly prepared in ink or typed. If a unit price or extension already entered by the bidder on the Bid and Award form is to be altered, it shall be crossed out and the new unit price or extension entered above or below and initialed by the bidder with ink. The bid shall be legally signed and the complete address of the bidder given thereon.

   All bids shall be tightly sealed in an envelope plainly marked SEALED BID and identified by project name, bid opening date and time. Bids opened by mistake, due to improper identification, will be so documented and resealed. The Purchasing Division will maintain and guarantee confidentiality of the contents until the specified opening date and time. Bids submitted by Fax machine will not be accepted.

3. **EXPLANATION TO BIDDERS**-Any binding explanation desired by a bidder regarding the meaning or interpretation of the Invitation for Bids (IFB) and attachments must be requested in writing, **at least 7 business days before the bid opening** so a reply may reach all prospective bidders before the submission of bids. Any information given to a prospective bidder concerning the IFB will be furnished to all prospective bidders as an amendment or addendum to the IFB if such information would be prejudicial to uninformed bidders. Receipt of amendments or addenda by a bidder must be acknowledged in the bid by attachment, or by letter or fax received before the time set for opening of bids. Oral explanation or instructions given prior to the opening will not be binding.

4. **CASH DISCOUNTS**-Discount offered for payment of less than thirty (30) days will not be considered in evaluating bids for award. Offered discounts of less than thirty (30) days will be taken if payment is made within the discount period, even though not considered in evaluation of the bid.

5. **WITHDRAWAL OF BIDS**-Bids may be withdrawn in person by a bidder or authorized representative, provided their identity is made known and a receipt is signed for the bid, but only if the withdrawal is made prior to the exact time set for receipt of bid. No bid may be withdrawn for at least ninety (90) days after bid opening.

6. **ALTERNATE BIDS**-bidders are cautioned that any alternate bid, unless specifically requested or any changes, insertions or omissions to the terms and conditions, specifications or any other requirement of this IFB may be considered non-responsive, and at the option of the City, result in rejection of the alternate bid.

7. **LATE BIDS**-Any bid received at the office designated herein after the exact time specified for receipt will not be considered. (Note: The City reserves the right to consider bids that have been determined by the City to be received late due to mishandling by the City after receipt of the bid and no award has been made.)

8. **UNIT PRICES**-If there is a discrepancy between unit prices and their extension, unit prices shall prevail.

SECTION II
BID AND AWARD

The undersigned having become thoroughly familiar with all of the Bidding Documents incorporated herein, the project site and the location conditions affecting the Work, hereby proposes and agrees to perform all Work in strict conformity with the requirements of these documents, and to provide and furnish all the equipment, labor and materials necessary to complete in a professional manner the furnishing and installing of all of the following, meeting or exceeding the specifications as set forth herein for the prices and times as stated below.

It is the intention of the City of Kalamazoo to perform all of the Work that the budget allows for the cost of the Work (other than excluded Work), determined as provided in the General Provisions & Conditions, together with the following fee, and subject to the Guaranteed Maximum Price.

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Lump Sum Bid Price:	**$**

Bidder agrees that the Work will be Substantially Complete on or before **December 31, 2023** and will be completed and ready for Final Payment in accordance with Section V herein on or before **June 30, 2024**.

Bidder shall provide all of the information as requested herein and as necessary for Bidder evaluation, which is in a referable and verifiable format, with their Bid. **Failure to do so and/or failure to provide post-bid requested information may be cause for rejecting the bid as non-responsive.**

Work shall start within **90** working days after receipt of notification by Contractor of Notice to Proceed.

Bidder/Contractor has examined and carefully studied the bidding documents and attachments, and hereby acknowledges receipt of the following addenda:

Addendum No: _____ _____ _____ _____ _____

Dated: _____ _____ _____ _____ _____

The City encourages the use of local labor in fulfilling the requirements of this contract.

By my signature below, I certify that the firm bidding on this contract, when making hiring decisions, does not use a past criminal conviction as a bar to or preclude a person with a criminal conviction from being considered for employment with the bidding firm unless otherwise precluded by federal or state law. I further certify that I have read and agree to be bound by the provisions of the City's Non-Discrimination Clause found in Appendix A as updated by City Ordinance 1856.

Signed: _____ Name: _____

Title: _____

CITY OF KALAMAZOO EX-OFFENDER POLICY CHECKLIST

As part of the City's commitment to reducing unacceptable poverty, encouraging rehabilitation, reducing recidivism and strengthening families in Kalamazoo, the City has updated its Purchasing Policy to ensure that firms with whom the City does business share in this commitment by utilizing hiring practices that do not unfairly deny people with arrest and conviction records gainful employment. *(Important: This requirement also extends to any subcontractors the bidder intends to use to fulfill the contract for goods or services being sought from the City.)*

Part I: Proof that the bidder does not inquire about an individual's past arrest or criminal history on the bidders employment application form

☐ Attach a copy of the current application for employment being used by the bidder

Part II: Certification that the bidder does not use an individual's past arrest or criminal history to unlawfully discriminate against them by checking *one or more* of the following:

☐ That pursuant to federal or state law bidder is precluded from hiring persons with certain criminal records from holding particular positions or engaging in certain occupations by providing a cite to the applicable statute or regulation; if checking this box, provide a citation to the applicable statute or rule upon which the bidder is relying:_____

☐ That bidder conducts criminal history background checks only as necessary, and only after making a conditional offer of employment; that any withdrawal of an offer of employment to an individual because of a past criminal history is job-related and consistent with business necessity after the individual has been provided an individualized assessment opportunity to review and challenge or supplement the history of past criminal conduct being relied upon by the bidder;

☐ That the use by bidder of criminal history background checks complies with the U.S. Equal Employment Opportunity Commission's Enforcement Guidance on the Consideration of Arrest and Conviction Records in Employment Decisions and that the bidder has not had a determination rendered against it in past 7 years that it discriminated against a person through the use of an individual's arrest or criminal history

I CERTIFY THAT THE ABOVE STATEMENTS ARE TRUE.

_____ _____
Date Signature

_____
Printed Name

_____
Position

CITY OF KALAMAZOO
LOCAL PREFERENCE POLICY AND CERTIFICATION

The lowest responsive Kalamazoo County bidder whose bid is not low but falls within 2% of the lowest responsive bid is afforded the opportunity to become the successful bidder if it agrees to reduce its bid to match the lowest responsive bid. The City of Kalamazoo is the sole determiner whether a bidder is responsible, qualifies as a Kalamazoo County bidder, and if its bid is responsive to the City's specifications, terms and conditions.

If the lowest Kalamazoo County bidder chooses not to match the lowest bid, the next lowest responsive Kalamazoo County bidder whose bid falls within 2% of the lowest bid, is given the opportunity to match the lowest responsive bid.

To qualify as a Kalamazoo County bidder, the bidder must meet both the following criteria:

1. Have a physical presence in Kalamazoo County by maintaining a permanent office, factory or other facility in Kalamazoo County with employees working in Kalamazoo County.

2. Have paid real or personal property taxes related to said business to the City of Kalamazoo, County of Kalamazoo or other municipal corporation within Kalamazoo County in the previous tax year, except that a non-profit entity need not meet this requirement.

This local preference policy applies only to purchases for materials, supplies, capital outlay, and services for maintenance, repair or operation of City facilities that are over $25,000. If more than 50% of the contract is sub-contracted to firms located outside of Kalamazoo County that bid does not qualify for the local preference policy outlined above. The local preference policy will not apply if prohibited by law. The Purchasing Agent has the authority to finally determine if the bidder qualifies as a Kalamazoo County bidder as set forth herein. The Purchasing Agent may take into account the permanency of the business in Kalamazoo, and whether the business appears to be claiming to be a Kalamazoo County business solely or primarily to qualify as a Kalamazoo County business under this Resolution, and any other material factors.

CERTIFICATION

If you qualify as a Kalamazoo County bidder and wish to be considered for the local preference provisions as provided above please certify that fact by providing the information requested below and attesting to its accuracy.

Firm Name:_____

Street Address of Business: _____

City, State, and Zip Code: _____

Number of employees working in Kalamazoo County: _____

Name the city or township to which business real and/or personal property taxes are paid or provide non-profit status:

_____

The above information is accurate:

Signature: _____ Date: _____

Title: _____

Revised April 2008

SUB-CONTRACTING INFORMATION

Using the table below provide information regarding the sub-contractors that will be working to fulfill the requirements of this contract. Submit as complete a list as possible at the time of your bid. You will have two business days after the bid opening to update the list as needed. The information provided will be used for evaluating your bid and to assist in determining if you qualify as a Kalamazoo County Bidder.

INSTRUCTIONS:
Nature of Contract - State a brief description of the work or product that will be provided.
BIDDER – Provide the percentage of services or construction activity that will be provided by your firm.
Subcontractors:

- Provide the Name and Address for each subcontractor providing services or construction activities for this contract.
- Indicate with **YES** or **NO** under the "Local?" box if they qualify as a "Kalamazoo County bidder" (see local preference certification page)
- Provide the percentage for the dollar amount of the contract work they will be performing.

If there are not enough lines in the table below make additional copies as needed.

Nature of Contract:		
Subcontractor Name/Address	***Local?***	**% Of Total Contract**
BIDDER		

Does this List of Subcontractors need to be updated after the bid opening? **Yes __ No __**

REFERENCE QUESTIONNAIRE

Please answer the following questions completely.

1. Firm name: _____

2. Established: Year _____ Number of Employees: _____

3. Type of organization:

   a. Individual: _____ b. Partnership: _____
   c. Corporation: _____ d. Other: _____

4. Former firm name(s) if any, and year(s) in business:
   _____

   _____

5. Include at least 3 references of contracts for similar work performed over the last five (5) years. Include: owner, contact person and phone number and description of work performed.

   5.1 Company Name: _____

   Address: _____

   Phone: _____

   Contact: _____

   Type of work or contract: _____

   5.2 Company Name: _____

   Address: _____

   Phone: _____

   Contact: _____

   Type of work or contract: _____

   5.3 Company Name: _____

   Address: _____

   Phone: _____

   Contact: _____

   Type of work or contract: _____

   I hereby certify that all of the information provided is true and answered to the best of my ability.

   Signed: _____ Name: _____
   (type or print)

   Title: _____ Date: _____

I hereby state that all of the information I have provided is true, accurate and complete. I hereby state that I have the authority to submit this bid which will become a binding contract if accepted by the City of Kalamazoo. I hereby state that I have not communicated with nor otherwise colluded with any other bidder, nor have I made any agreement with nor offered/accepted anything of value to/from an official or employee of the City of Kalamazoo that would tend to destroy or hinder free competition.

The firm's identification information provided will be used by the City for purchase orders, payment and other contractual purposes. If the contractual relationship is with, or the payment made to, another firm please provide a complete explanation on your letterhead and attach to your bid. Please provide for accounts payable purposes:

Tax Identification Number (Federal ID): _____

Remittance Address:_____

Financial Contact Name:_____ Financial Contact Phone Number:_____

Financial Contact Email Address:_____

I hereby state that I have read, understand and agree to be bound by all terms and conditions of this bid document.

SIGNED: _____ NAME: _____
(Type or Print)

TITLE: _____ DATE: _____

FIRM NAME: _____
(if any)

ADDRESS: _____
(Street address) (City) (State) (Zip)

PHONE: _____ FAX: _____

EMAIL ADDRESS: _____

FOR CITY USE ONLY - DO NOT WRITE BELOW

NOTE: *This blanket addendum is for informational purposes only and does not need to be acknowledged by bidders in their submission.*

COVID-19 ADDENDUM #2
January 1, 2022

TO: **ALL Prospective Bidders**
PROJECT: **ALL Upcoming Projects**

The purpose of this addendum is to clarify and/or modify the sealed bid delivery and bid opening process for all upcoming projects. All work affected is subject to all applicable terms and conditions of the Bidding and Contract Documents.

1. UPDATE TO SEALED BID DELIVERY AND BID OPENING POLICY:

Effective immediately and continuing until further notice, the City of Kalamazoo will return to IN-PERSON bid openings following City Hall guidelines, including Mask Mandate.

BIDS MUST BE RECEIVED BEFORE THE DUE DATE AND TIME – LATE BIDS WILL NOT BE CONSIDERED.

Bidders can submit sealed bids in one of the following ways:

- **Mail your bid,** to be received before the bid due date and time indicated in the bid document, to the City of Kalamazoo at the following address:

  City of Kalamazoo
  Purchasing Division
  241 West South Street
  Kalamazoo, MI 49007

- **Deliver your bid to the Treasurer's Office Payment Drop Box** located in the northwest corner of City Hall before the bid due date and time indicated in the bid document.

- **Deliver your bid to City Hall In Person before** the bid due date and time indicated in the bid document.

All bids shall be tightly sealed in an envelope plainly marked SEALED BID and identified by project name, bid opening date and time. Bids opened by mistake, due to improper identification, will be so documented and resealed. The Purchasing Division will maintain and guarantee confidentiality of the contents until the specified opening date and time. Bids submitted by fax machine or email will not be accepted.

The Purchasing Division will post bid tabulations to the City of Kalamazoo website within 24 hours after the bid opening date and time at: https://www.kalamazoocity.org/bidopportunities.

Questions regarding this sealed bid delivery and bid opening policy change related to the COVID-19 virus should be directed to the City of Kalamazoo at (269) 337-8020.

Sincerely,

Michelle Emig
Purchasing Division Manager

SECTION III
CITY OF KALAMAZOO
INDEMNITY AND INSURANCE

Contractor, or any of their subcontractors, shall not commence work under this contract until they have obtained the insurance required under this paragraph, and shall keep such insurance in force during the entire life of this contract. All coverage shall be with insurance companies licensed and admitted to do business in the State of Michigan and acceptable to the City of Kalamazoo within ten (10) days of the Notice of Award. The requirements below should not be interpreted to limit the liability of the Contractor. All deductibles and SIR's are the responsibility of the Contractor.

The Contractor shall procure and maintain the following insurance coverage:

Workers' Compensation Insurance including Employers' Liability Coverage, in accordance with all applicable statutes of the State of Michigan.

Commercial General Liability Insurance on an "Occurrence Basis" with limits of liability not less than $1,000,000 per occurrence and aggregate. Coverage shall include the following extensions: (A) Contractual Liability; (B) Products and Completed Operations; (C) Independent Contractors Coverage; (D) Broad Form General Liability Extensions or equivalent, if not already included and (E) XCU coverage if the nature of the contract requires XC or U work.

Automobile Liability in accordance with all applicable statutes of the State of Michigan, with limits of liability not less than $1,000,000 per occurrence, combined single limit for Bodily Injury, and Property Damage. Coverage shall include all owned vehicles, all non-owned vehicles, and all hired vehicles.

Additional Insured: Commercial General Liability and Automobile Liability, as described above, shall include an endorsement stating that the following shall be *Additional Insureds*: The City of Kalamazoo, all elected and appointed officials, all employees and volunteers, all boards, commissions, and/or authorities and board members, including employees and volunteers thereof. It is understood and agreed that by naming the City of Kalamazoo as additional insured, coverage afforded is considered to be primary and any other insurance the City of Kalamazoo may have in effect shall be considered secondary and/or excess.

To the fullest extent permitted by law the Contractor agrees to pay on behalf of, indemnify, and hold harmless the City of Kalamazoo, its elected and appointed officials, and employees against any claims, demands, suits, or loss, including all costs connected therewith, and for any damages which may be asserted, claimed, or recovered against or from the City of Kalamazoo, by reason of personal injury, including bodily injury or death and/or property damage, including loss of use thereof, caused in whole or part by any negligent act or omission by the Contractor, its employees, agents, or officers which arises out of, or is in any way connected or associated with, this contract.

Cancellation Notice: All policies, as described above, shall include an endorsement stating that it is understood and agreed that thirty (30) days, or ten (10) days for non-payment of premium, Advance Written Notice of Cancellation, Non-Renewal, Reduction, and/or Material Change shall be sent to: City of Kalamazoo, Purchasing Division, 241 W. South Street, Kalamazoo, MI 49007.

Proof of Insurance Coverage: The Contractor shall provide the City of Kalamazoo at the time that the contracts are returned by him/her for execution, or within 10 days of Notice of Award, whichever is earlier, a Certificate of Insurance as well as the required endorsements. In lieu of required endorsements, if applicable, a copy of the policy sections where coverage is provided for additional insured and cancellation notice would be acceptable. Copies or certified copies of all policies mentioned above shall be furnished, if so requested.

INDEMNITY AND INSURANCE
Continued

If any of the above coverages expire during the term of this contract, the Contractor shall deliver renewal certificates and/or policies to City of Kalamazoo at least ten (10) days prior to the expiration date.

Scope of Coverage: The above requirements and conditions shall not be interpreted to limit the liability of the Contractor under this Contract, but shall be interpreted to provide the greatest benefit to the City and its officers and employees. The above listed coverages shall protect the Contractor, its employees, agents, representatives and subcontractors against claims arising out of the work performed. It shall be the Contractor's responsibility to provide similar insurance for each subcontractor or to provide evidence that each subcontractor carries such insurance in like amount prior to the time such subcontractor proceeds to perform under the contract.

SECTION IV
SPECIAL REQUIREMENTS

1. BID BOND/GUARANTEE

The bid must be accompanied by a bid bond which shall not be less than five (5%) percent of the total amount of the bid. No bid will be considered unless it is accompanied by the required guarantee. The bid guarantee shall ensure the execution of the bid and award, and the furnishing of a performance bond and a labor and material bond (A and B below) by the successful bidder. (Contractors Note: A cashier's or certified check in lieu of a bid bond is **NOT** acceptable.)

A. PERFORMANCE BOND

A performance bond shall be furnished in the full amount of the contract ensuring the City of faithful performance of all the provisions of the contract, and the satisfactory performance of any equipment required hereunder. The bond shall also ensure the City against defective workmanship and/or materials.

B. LABOR AND MATERIAL (PAYMENT) BOND

A labor and material (payment) bond shall be furnished for the period covered by the contract, in the full amount of the contract for the protection of labor and material suppliers and sub-contractors.

Bonds shall be secured by a guaranty or a surety company listed in the latest issue of the U.S. Treasury, circular 570, and licensed to do business in the State of Michigan, and written in favor of the City of Kalamazoo. The amount of such bonds shall be within the maximum amount specified for such company in said circular 570. The bonds shall be accompanied by a power of attorney showing authority of the bonding agent to sign such bonds on behalf of the guaranty or surety company. The cost of the bonds shall be borne by the Contractor.

Failure of the Contractor to supply the required bonds within ten (10) days after Notice of Award, or within such extended period as the Purchasing Agent may agree to, shall constitute a default and the City of Kalamazoo may either award this contract to the next lowest bidder or re-advertise for bids and may charge against the Contractor for the difference between the amount of the bid and the amount for which a contract for the work is subsequently executed, irrespective of whether the amount thus due exceeds the amount of the bid bond. If a more favorable bid is received by re-advertising, the defaulting bidder shall have no claim against the City of Kalamazoo for a refund.

2. WAIVERS OF LIEN

Upon completion of all work and request for final payment, the Contractor shall furnish a 100% waiver of lien from each supplier and sub-contractor covering all items of the work. Failure to supply waivers of lien for the entire job upon completion and final payment request will be considered grounds for withholding final payment.

3. SUBCONTRACTORS

A. Contractors shall state on the Bid and Award page any and all subcontractors to be associated with their bid, including the type work to be performed. Any and all subcontractors shall be bound by all of the terms, conditions and requirements of the contract; however, the prime contractor shall be responsible for the performance of the total work requirements.

B. The Contractor shall cooperate with the City of Kalamazoo in meeting its commitments and goals with regard to maximum utilization of minority and women business enterprise, and shall use its best efforts to ensure that minority and women business enterprises have maximum practicable opportunity to compete for subcontract work under this agreement.

4. PREVAILING WAGES

This project is estimated to go over the $100,000 prevailing wage threshold. The successful bidder will be required to comply with Section 2-125 of the Code of Ordinances of the City of Kalamazoo regarding prevailing wages and Appendix B attached, incorporated herein by reference. Special note: This provision applies only to projects in excess of $100,000 for City ($2,000 federal) funded projects.

The City's requirements as it relates to prevailing wages includes a meeting with the City's Project Manager **prior** to work and payroll and work monitoring during the duration of the contract. Please contact Purchasing at (269) 337-8020 if you have any questions regarding Davis-Bacon provisions.

SECTION V
GENERAL PROVISIONS & CONDITIONS

1. INTENT

It is the intent of these Bidding Documents to provide for a Contractor who shall provide all labor, materials, tools and equipment necessary to successfully perform and complete in a professional manner for the Work as described in the Bidding Documents.

2. SCOPE OF WORK

This Contract includes, but is not limited to; all Work as shown on the Drawings (***Attachment D***) and described in the Specifications (***Attachment C***) for the installation of piping, valves, wastewater treatment process equipment, pumps, HVAC ducting and equipment, medium and low voltage AC electrical distribution & supply, AC & DC electrical controls, painting and industrial coating, structural concrete erection and placement, structural steel erection, metal building erection, paving and site improvements at the City of Kalamazoo Water Reclamation Plant.

Contractor to provide labor and equipment to off-load and move into City storage facility all delivered equipment necessary for completion of the project. Off-loading may need to occur at various times over a three (3)-month period. This work is weather dependent and will need to be scheduled around any snowy or icy conditions.

3. QUESTIONS, INTERPRETATIONS & ADDENDA

All questions about the meaning or intent of the Bidding Documents are to be submitted to City of Kalamazoo in writing by the Bidder. Interpretations or clarifications considered necessary by City of Kalamazoo in response to such questions will be issued by Addenda as posted on the City of Kalamazoo's website. Questions received less than seven (7) business days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

Questions regarding the Drawings or Specifications shall be submitted to Ryan Stoughton, PE, Assistant City Engineer at stoughtonr@kalamazoocity.org.

Questions regarding terms, conditions, and other related Bid Requirements may be submitted to Craig Hull, Buyer at hullc@kalamazoocity.org.

Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

4. BIDDING DOCUMENTS

Complete Bidding Documents may be obtained from the City of Kalamazoo's website, www.kalamazoocity.org/bidopportunities.

Complete Bidding Documents shall be used in preparing Bids; neither City of Kalamazoo nor Designer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

City of Kalamazoo, in making Bidding Documents available on the provisions herein, do so only for the purposes of City of Kalamazoo and do not authorize or confer a license for any other use.

5. DESIGNER & OWNER'S REPRESENTATIVE

The part of the Work that pertains to these Bidding Documents has been designed by Jones & Henry Engineers, LTD "Designer". Designer shall have the duties and responsibilities of this Contract granted to Designer by City of Kalamazoo

City of Kalamazoo may retain professional services to act as City of Kalamazoo's Representative in connection with the successful completion of the Work in accordance with the Contract

Documents. Representative shall have the duties and responsibilities of this Contract granted to Representative by City of Kalamazoo.

6. MANDATORY PRE-BID MEETING AND SITE INSPECTION

A MANDATORY Pre-Bid Meeting will be held at the times and location stated in the IFB. Representatives of City of Kalamazoo and Designer will be present to discuss the Project. A site inspection will immediately follow the Mandatory Pre-Bid Meeting. **Bidders are required to attend, participate in the conference, and sign the Mandatory Pre-Bid Meeting Attendance List to be eligible to bid on this project.** Each change or addendum issued in relation to this IFB will be posted on the City's website at https://www.kalamazoocity.org/bidopportunities. It shall be the bidder's responsibility to make inquiry as to the changes or addenda issued. All such changes or addenda shall become part of the contract and all bidders shall be bound by such changes or addenda. In order for a bid to be responsive, all addenda must be acknowledged with the bid. If you have already submitted your bid, acknowledge receipt and acceptance of addenda by signing in the place provided and returning them to the Purchasing Division and they shall be incorporated in your bid. Please identify your return envelope with the bid reference number and project description. Oral statements may not be relied upon and will not be binding or legally effective.

Mandatory Pre-Bid Meeting is only required of Bidders to be classified as responsive. Sub-Contractors and Suppliers are **not** required to attend mandatory pre-Bid meetings for a Bidder to be classified as responsive.

The Mandatory Pre-Bid Meeting will be held Wednesday, March 9, 2022 at 10:00 a.m. Local Time at 1415 Harrison St., Kalamazoo, MI, Kalamazoo Water Reclamation Plant, Administration Building, Conference Room A.

7. CONTRACT TIMES

The date for Substantial Completion and completion and readiness for Final Payment are stated in Section II Bid and Award.

Bidder will be assessed liquidated damages at the rate stated in the Bidding Documents for failure to attain Substantial Completion within the date stated on the Bid Form.

The date for Substantial Completion and completion and readiness for Final Payment as stated in the Contract Documents are of the essence of the Contract.

8. EVALUATIONS OF BIDS

In evaluating whether a Bidder is responsible, City of Kalamazoo will consider the qualifications and experience of the Bidder and any Subcontractor whose percent of total Contract is greater than or equal to 10 percent and may consider the qualifications and experience of remaining Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers are provided in the Bidding Documents.

City of Kalamazoo may conduct such investigations as City of Kalamazoo deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

9. VARIATIONS TO SPECIFICATIONS

For purposes of evaluation, the bidder MUST indicate any variances from our specifications, terms and/or conditions, no matter how slight. If variations are not stated in the Submitted Bid, it will be assumed that the product or service fully complies with our specifications, terms and conditions.

10. SITE & OTHER AREAS

The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by City of Kalamazoo for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

11. EXISTING SITE CONDITIONS

City of Kalamazoo will provide access to reports and drawings referenced below available to any Bidder upon request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

Record Drawings of previous work at the Site is available for review and reference by Bidder upon the request of Bidder.

Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or adjacent to the Site are set forth in the Contract Documents and are based upon information and data furnished to City of Kalamazoo and Designer by owners of such Underground Facilities, including City of Kalamazoo, or others.

12. EXAMINATION OF SITE

Bidder may conduct Site visits by appointment only with completion during normal working hours, 8:00am to 4:00pm EST, and shall not disturb any ongoing operations at the Site.

Bidder shall follow any and all governing safety protocols, including but not limited to MiOSHA, State and Local Health Departments, State and Federal Executive Order(s), and City of Kalamazoo Protocol(s).

Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

On request, and to the extent City of Kalamazoo has control over the Site, and schedule permitting, the City of Kalamazoo will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. City of Kalamazoo will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on City of Kalamazoo's authority regarding the Site.

Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by City of Kalamazoo or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

13. LAYING OUT WORK

Before submitting a Bid the Bidder shall verify all measurements and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of differences between actual dimensions and the measurements indicated on the drawings. Any difference that

may be found shall be submitted to City of Kalamazoo for consideration before proceeding. City of Kalamazoo will provide construction staking for the project.

14. SAFETY STANDARDS

The Bidder warrants that the products supplied to City of Kalamazoo conform in all respects to the standards set forth in the Occupational Safety and Health Act of 1970 and its amendments and the failure to comply with this condition will be considered a breach of contract.

15. PRODUCT/SYSTEM SUBSTITUTIONS & "OR-EQUAL" ITEMS

Bidder shall submit a written request, to be received not later than 10 days prior to scheduled bid opening, for Substitution of any Product named. If no substitutions are submitted, it will be reasonably concluded by the City of Kalamazoo and Designer that the specified Product will be incorporated into the Work and the Bidder will be committed to supplying the specified Product. Request shall include three complete copies which :

describe in detail any variance to the Product specified. All proposed substitution for specified items shall be substantially the same size (height, length, width, diameter, etc.), type, color, construction quality and shall meet the design intent to be considered for substitution for the Product specified;

document each request with complete data substantiating compliance of proposed Substitution with Product specified including written certification that Product conforms to or exceeds all requirements of the Product specified;

document all coordination information, including a list of changes or modifications needed to the Bid Documents or other parts of the Work and to construction performed by the City of Kalamazoo and separate contractors that will become necessary to accommodate the proposed substitution.; and

provide name, address and telephone number of manufacturer's authorized representative.

Approval of the Substitution request, if given, will be in the form of an addendum issued prior to scheduled Bid opening date and hour at local time.

16. SAMPLES & DEMONSTRATIONS

Evidence in the form of samples may be requested. Such samples are to be furnished after the date of bid opening only upon request of City of Kalamazoo unless otherwise stated in the bid proposal. If samples should be requested, such samples must be received by the City of Kalamazoo no later than seven (7) days after formal request is made. When required, the City of Kalamazoo may request full demonstrations of any unit(s) bid prior to the award of any contract. Samples, when requested, must be furnished free of expense to the City of Kalamazoo and if not used in testing or destroyed, will upon request within thirty (30) days of bid award be returned at the bidder's request.

17. SUBCONTRACTORS, SUPPLIERS, & OTHERS

A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

Subsequent to the submittal of the Bid, City of Kalamazoo may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to City of Kalamazoo a list of the Subcontractors or Suppliers proposed for the following portions of the Work which are not included in the Bid on the sub-contracting information

form: City Water Main & Service, Building Erection, Electrical, Mechanical-HVAC, Mechanical-Millwright & Pipefitter, Plumber, Structural Concrete Formwork and Placement, Concrete Supplier, Concrete Reinforcement Supplier, Excavation & sitework, Concrete Curb & Gutter and Flatwork, Paving.

If City of Kalamazoo or Designer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, City of Kalamazoo may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and City of Kalamazoo may consider such price adjustment in evaluating Bids and making the Contract award.

If apparent Successful Bidder declines to make any such substitution, City of Kalamazoo may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which City of Kalamazoo makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to City of Kalamazoo subject to subsequent revocation of such acceptance as provided in these General Provisions & Conditions.

18. BIDDER'S REPRESENTATIONS

In submitting this Bid, Bidder represents that:

Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and acknowledges receipt of the following Addenda.

Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.

Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

Bidder is aware of the general nature of work to be performed by City of Kalamazoo and others at the Site that relates to the Work as indicated in the Bidding Documents.

Bidder has given City of Kalamazoo written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by City of Kalamazoo is acceptable to Bidder.

The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

19. BIDDER'S CERTIFICATION

Bidder certifies that:

This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

Bidder has not solicited or induced any individual or entity to refrain from bidding; and

Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph:

"corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

"fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of City of Kalamazoo, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive City of Kalamazoo of the benefits of free and open competition;

"collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of City of Kalamazoo, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

"coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

20. DEFINITIONS & TERMINOLOGY

Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

Addenda—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

Agreement—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

Application for Payment—The form acceptable to Representative which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

Bid—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bidder—An individual or entity that submits a Bid to City of Kalamazoo.

Bidding Documents—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

Bidding Requirements—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

Change Order—A document which is signed by Contractor and City of Kalamazoo and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

Change Proposal—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Representative concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

City – See "Owner"

City of Kalamazoo – See "Owner"

Claim—(a) A demand or assertion by City of Kalamazoo directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Representative concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Representative's decision regarding a Change Proposal; seeking resolution of a contractual issue that Representative has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to City of Kalamazoo, duly submitted in compliance with the procedural requirements set forth herein, contesting Representative's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Representative has declined to address. A demand for money or services by a third party is not a Claim.

Constituent of Concern—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

Contract—The entire and integrated written contract between the City of Kalamazoo and Contractor concerning the Work.

Contract Documents—Those items so designated in the Agreement, and which together comprise the Contract.

Contract Price—The money that City of Kalamazoo has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

Contract Times—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

Contractor—The individual or entity with which City of Kalamazoo has contracted for performance of the Work.

Cost of the Work—See Paragraph 13.01 for definition.

Designer – The individual or entity named as such in the Bidding and Construction Documents.

Drawings—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

Effective Date of the Contract—The date, indicated in the Agreement, on which the Contract becomes effective.

Engineer—The individual or entity named as such in the Bidding and Construction Documents.

Field Order—A written order issued by Representative which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

Firm—The individual or entity named as such in the Bidding and Construction Documents.

Hazardous Environmental Condition—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

Laws and Regulations; Laws or Regulations—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

Liens—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

Milestone—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

Notice of Award—The written notice by City of Kalamazoo to a Bidder of City of Kalamazoo's acceptance of the Bid.

Notice to Proceed—A written notice by City of Kalamazoo to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

Owner—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

Progress Schedule—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

Project—The total undertaking to be accomplished for City of Kalamazoo by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

Project Manual—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

Representative—The individual or entity named as such in the Bidding and/or Construction Documents.

Resident Project Representative—The authorized representative of Representative assigned to assist Representative at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

Samples—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

Schedule of Application for Payment – A schedule, prepared and maintained by Contractor, of date and value of Application for Payment for City of Kalamazoo's review.

Schedule of Submittals—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Designer's review of the submittals and the performance of related construction activities.

Schedule of Values—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

Shop Drawings—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

Site—Lands or areas indicated in the Contract Documents as being furnished by City of Kalamazoo upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by City of Kalamazoo which are designated for the use of Contractor.

Specifications—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

Subcontractor—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

Substantial Completion—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Representative, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

Successful Bidder—The Bidder whose Bid the City of Kalamazoo accepts, and to which the City of Kalamazoo makes an award of contract, subject to stated conditions.

Supplementary Conditions—The part of the Contract that amends or supplements these General Conditions.

Supplier—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

Technical Data—Those items expressly identified as Technical Data in the Contract Documents, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site stated herein.

Underground Facilities—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

Unit Price Work—Work to be paid for on the basis of unit prices.

Work—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

Work Change Directive—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by City of Kalamazoo and recommended by Representative, ordering an addition, deletion, or revision in the Work.

The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

Intent of Certain Terms or Adjectives:

The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Designer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Designer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Designer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

Day:

The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

Defective:

The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

does not conform to the Contract Documents; or

does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

has been damaged prior to Representative's recommendation of final payment (unless responsibility for the protection thereof has been assumed by City of Kalamazoo at Substantial Completion).

Furnish, Install, Perform, Provide:

The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

21. PRELIMINARY MATTERS

Before Starting Construction

Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to City of Kalamazoo for timely review:

a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

a preliminary Schedule of Submittals;

a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work; and

a preliminary Schedule of Applications for Payment.

Preconstruction Conference; Designation of Authorized Representatives

Before any Work at the Site is started, a conference attended by City of Kalamazoo, Contractor, Designer, Representative, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in the Contract Documents, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

At this conference City of Kalamazoo and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract, not identified herein. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

Initial Acceptance of Schedules

At least 10 days before submission of the first Application for Payment a conference, attended by City of Kalamazoo, Contractor, Designer, Representative, and others as appropriate, will be held to review for acceptability as provided below the schedules submitted in accordance with the Contract Documents. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to City of Kalamazoo.

The Progress Schedule will be acceptable to City of Kalamazoo if it provides an orderly progression of the Work to completion within the Contract Times, coordinated with all aspects of the Work occurring at the Site, and signed by the necessary Subcontractors required for Contractor to complete the Work. Such acceptance will not impose on City of Kalamazoo responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

Failure on the part of the Contractor to carry out the provisions of the Progress Schedule as accepted may be considered sufficient cause to prevent bar Contractor from future contract awards until a satisfactory rate of progress is again established.

Contractor's Schedule of Submittals will be acceptable to Designer if it provides a workable arrangement for reviewing and processing the required submittals.

Contractor's Schedule of Values will be acceptable to City of Kalamazoo as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

Contractor's Schedule of Applications for Payment will be acceptable to Representative as to form and substance if it provides a reasonable allocation of the Schedule of Values to the Progress Schedule.

Electronic Transmittals

Except as otherwise stated elsewhere in the Contract, the City of Kalamazoo, Designer, Representative, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

If the Contract does not establish protocols for electronic or digital transmittals, then City of Kalamazoo, Designer, Representative, and Contractor shall jointly develop such protocols.

When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing

from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

Electronic files are provided to you for your convenience. Because electronic files can deteriorate or be damaged or be modified inadvertently or information from the electronic documents may be presented to you on your system differently than the original because of your software or system setup, these files may not be accurate. Any conclusion or information obtained or derived from such electronic files will be at your sole risk.

Information contained in the electronic documents is for information and reference in connection with this project only. The information is not intended or represented to be suitable for reuse on extensions of the original project or on any other project.

You should perform an acceptance test of the electronic documents immediately and inform us of any problems with the electronic documents. Jones & Henry will not be responsible for providing additional copies of these electronic files to you after 60 days from the date the documents are provided to you.

22. **DOCUMENT INTENT**

The Contract Documents are complementary; what is required by one is as binding as if required by all.

It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version, as printed by City of Kalamazoo, shall govern.

The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

City of Kalamazoo will issue clarifications and interpretations of the Contract Documents as provided herein.

23. **REFERENCE STANDARDS**

Standards Specifications, Codes, Laws and Regulations

Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of City of Kalamazoo, Contractor, or Designer, Representative, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for City of Kalamazoo and Designer. No such provision or instruction shall be effective to assign to City of Kalamazoo, Designer, Representative, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the

provisions of the part of the Contract Documents prepared by or for City of Kalamazoo and Designer.

24. REPORTING AND RESOLVING DISCREPANCIES

Reporting Discrepancies:

Contractor's Verification of Figures and Field Measurements: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to City of Kalamazoo any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Designer, or by an amendment or supplement to the Contract Documents.

Contractor's Review of Contract Documents: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to City of Kalamazoo in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Designer, or by an amendment or supplement to the Contract Documents issued pursuant to the Contract Documents.

Resolving Discrepancies:

Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for City of Kalamazoo shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

25. REQUIREMENTS OF THE CONTRACT DOCUMENTS

During the performance of the Work and until final payment, Contractor, Designer, and Representative shall submit to the City of Kalamazoo all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Designer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

City of Kalamazoo will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. City of Kalamazoo's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on City of Kalamazoo, unless it appeals by filing a Claim.

If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the

design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then City of Kalamazoo will solely provide a decision or interpretation.

26. **REUSE OF DOCUMENTS**

Contractor and its Subcontractors and Suppliers shall not:

have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Designer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of City of Kalamazoo and Designer and specific written verification or adaptation by Designer; or

have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without City of Kalamazoo's express written consent, or violate any copyrights pertaining to such Contract Documents.

The prohibitions will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

27. **COMMENCEMENT OF CONTRACT TIMES; NOTICE TO PROCEED**

The Contract Times will commence to run on the day indicated in the Notice to Proceed.

28. **STARTING THE WORK**

Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

29. **REFERENCE POINTS**

City of Kalamazoo shall provide engineering surveys to establish reference points for construction which in Designer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of City of Kalamazoo. Contractor shall report to Representative whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

30. **PROGRESS SCHEDULE**

Contractor shall adhere to the approved Progress Schedule as it may be adjusted from time to time as provided below.

Contractor shall submit to Representative for acceptance proposed adjustments in the Progress Schedule that will not result in changing the Contract Times nor Contract Price.

Proposed adjustments in the Progress Schedule that will change the Contract Times or Contract Price shall be submitted to Representative for review by City of Kalamazoo.

Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with City of Kalamazoo. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, or as City of Kalamazoo and Contractor may otherwise agree in writing.

Work of a similar nature may be added to this contract if agreed to by City of Kalamazoo and Contractor. In the event that work is added, the Progress Schedule for the Work will remain unchanged. Any Contract time added for additional work will be applied to that additional work

only, and cannot be added to Work in the original Contract. Any Work which has not reached Substantial Completion within the date stated herein, as adjusted per the provisions of the Contract, will be subject to Liquidated Damages regardless of any work that may be added at a later date.

31. DELAYS IN CONTRACTOR'S PROGRESS

If City of Kalamazoo, Designer, Representative, or anyone for whom City of Kalamazoo is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, tardiness, or interference caused by or within the control of Contractor. Delay, disruption, tardiness, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of City of Kalamazoo, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times upon the receipt of satisfactory documented evidence of such. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times such that an orderly prosecution of the Work is prevented by such delay, disruption, or interference. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

abnormal weather conditions;

acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the City of Kalamazoo);

acts of war or terrorism; and

Executive Orders or legislative rulings.

Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions.

Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

32. AVAILABILITY OF LANDS

City of Kalamazoo will furnish fair and reasonable access to the Site within the working schedules of City of Kalamazoo and Contractor. City of Kalamazoo will notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

Upon reasonable written request, City of Kalamazoo shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and City of Kalamazoo's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

33. **USE OF SITE AND OTHER AREAS**

Limitation on Use of Site and Other Areas:

Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless City of Kalamazoo, Designer, Representative, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against City of Kalamazoo, Designer, Representative, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

Removal of Debris During Performance of the Work: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations. Contractor shall remove all waste materials, rubbish, and other debris daily.

Cleaning: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by City of Kalamazoo. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

Loading of Structures: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

34. SUBSURFACE AND PHYSICAL CONDITIONS

Reports and Drawings: The City of Kalamazoo may have, however, makes no guarantee there of,:

reports of explorations and tests of subsurface conditions at or adjacent to the Site;

record drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

Technical Data contained in such reports and drawings.

Inability to Produce Reports or Drawings: No reports of explorations or tests of subsurface conditions at or adjacent to the Site, or drawings of physical conditions related to existing surface or subsurface structure at the Site, are known to City of Kalamazoo.

Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against City of Kalamazoo, Designer, Representative, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

35. DIFFERING SUBSURFACE OR PHYSICAL CONDITIONS

Notice by Contractor: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely is materially inaccurate; or

is of such a nature as to require a change in the Drawings or Specifications; or

differs materially from that shown or indicated in the Contract Documents; or

is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency), notify City of Kalamazoo in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

Designer's Review: After receipt of written notice as required by the preceding paragraph, Designer will promptly review the subsurface or physical condition in question; determine the necessity of City of Kalamazoo's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories stated

herein; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to City of Kalamazoo regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise City of Kalamazoo in writing of Engineer's findings, conclusions, and recommendations.

City of Kalamazoo's Statement to Contractor Regarding Site Condition: After receipt of Designer's written findings, conclusions, and recommendations, City of Kalamazoo shall issue a written statement to Contractor (with a copy to Designer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

Possible Price and Times Adjustments:

Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

such condition must fall within any one or more of the categories described herein;

Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

Contractor knew of the existence of such condition at the time Contractor made a commitment to City of Kalamazoo with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

Contractor failed to give the written notice.

If City of Kalamazoo and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Contract Supplemental and Purchase Order Change Order.

Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after City of Kalamazoo's issuance of the City of Kalamazoo's written statement to Contractor regarding the subsurface or physical condition in question.

36. **UNDERGROUND FACILITIES**

Contractor's Responsibilities: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to City of Kalamazoo or Designer by the owners of such Underground Facilities, including City of Kalamazoo, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

City of Kalamazoo and Designer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

reviewing and checking all information and data regarding existing Underground Facilities at the Site;

locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

coordination of the Work with the owners (including City of Kalamazoo) of such Underground Facilities, during construction; and

the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

Notice by Contractor: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency), identify the owner of such Underground Facility and give written notice to that owner and to City of Kalamazoo and Engineer.

Designer's Review: Designer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to City of Kalamazoo regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise City of Kalamazoo in writing of Designer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

City of Kalamazoo's Statement to Contractor Regarding Underground Facility: After receipt of Designer's written findings, conclusions, and recommendations, City of Kalamazoo shall issue a written statement to Contractor (with a copy to Designer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Designer's written findings, conclusions, and recommendations in whole or in part.

Possible Price and Times Adjustments:

Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

Contractor gave the notice.

If City of Kalamazoo and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Contract Supplemental & Purchase Order Change Order.

Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after City of Kalamazoo's issuance of the City of Kalamazoo's written statement to Contractor regarding the Underground Facility in question.

37. **HAZARDOUS ENVIRONMENTAL CONDITIONS AT SITE**

Reports and Drawings: City of Kalamazoo may have:

reports and drawings known to City of Kalamazoo relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

Technical Data contained in such reports and drawings.

Inability to Produce Reports or Drawings: No reports or drawings related to Hazardous Environmental Conditions at the Site are known to City of Kalamazoo.

Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against City of Kalamazoo, Designer, Representative, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency); and (3) notify City of Kalamazoo and Designer (and promptly thereafter confirm such notice in writing). City of Kalamazoo, in consult with Designer, determine

the necessity for City of Kalamazoo to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Designer, City of Kalamazoo shall take such actions as are necessary to permit City of Kalamazoo to timely obtain required permits and provide Contractor the written notice. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then City of Kalamazoo may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after City of Kalamazoo has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

If City of Kalamazoo and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of City of Kalamazoo's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or City of Kalamazoo may impose a set-off.

If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then City of Kalamazoo may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures. City of Kalamazoo may have such deleted portion of the Work performed by City of Kalamazoo's own forces or others.

To the fullest extent permitted by Laws and Regulations, City of Kalamazoo shall indemnify and hold harmless Contractor, Subcontractors, Designer, Representative, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph shall obligate City of Kalamazoo to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless City of Kalamazoo, Designer, Representative and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible.

38. ACCOUNTING RECORDS

Contractor shall keep such full and detailed accounts of materials incorporated and labor and equipment utilized for the Work consistent with the requirements of the Contract Documents and as

may be necessary for proper financial management under this Contract. Subject to prior written notice, City of Kalamazoo shall be afforded reasonable access during normal business hours to all Contractor's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years, or longer if required by law, after the final payment by City of Kalamazoo.

39. PRICE & COST OF THE WORK

The City of Kalamazoo will pay Contractor for completion of the Work in accordance with the Contract Documents the lump sum amount stated in their Bid, subject to approved adjustments under the Contract.

Contractor guarantees that the maximum amount payable by City of Kalamazoo for the completion of the Work will not exceed the lump sum amount stated in their Bid, subject to increases or decreases for changes in the Work.

Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph are used for two distinct purposes:

To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

Costs Included: Except as otherwise may be agreed to in writing by City of Kalamazoo, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project and shall include only the following items:

Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by City of Kalamazoo and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by City of Kalamazoo.

Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless City of Kalamazoo deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to City of Kalamazoo. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to City of Kalamazoo, and Contractor shall make provisions so that they may be obtained.

Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by City of Kalamazoo, Contractor shall obtain competitive bids from subcontractors acceptable to City of Kalamazoo and Contractor and shall deliver such bids to City of Kalamazoo, who will then determine, with the advice of Representative, which bids, if any, will be acceptable. If any

subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

Supplemental costs including the following:

The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with, the current at time of Bid opening, MDOT Equipment Rental Rates Schedule C. In the event a construction equipment or machinery isn't included within or incapable of being classified within the MDOT Equipment Rental Rates Schedule C, in accordance with rental agreements approved by City of Kalamazoo with the advice of Representative, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of City of Kalamazoo. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

The cost of utilities, fuel, and sanitary facilities at the Site.

Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

Costs Excluded: The term Cost of the Work shall not include any of the following items:

Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in

Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications or specifically covered herein. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in herein.

Contractor's Fee: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the herein. When the value of any Work covered by a Supplemental, Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth herein.

Documentation: Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to City of Kalamazoo an itemized cost breakdown together with supporting data.

40. APPLICATION FOR PAYMENT PROCEDURES

Contractor shall be responsible for the generation and submission of invoices for payment in accordance with the Contract Documents. Payment will be generated by City of Kalamazoo based upon an approved invoice. Recommended frequency of payment is monthly, however, frequency of payment will not exceed bi-weekly.

41. SUBMITTAL AND PROCESSING OF PAYMENTS

Contractor shall submit Applications for Payment in accordance with the Contract Documents. Applications for Payment will indicate the amount of Contractor's fee then payable. Applications for Payment will be processed by City of Kalamazoo and/or its assigned Representative as provided in the General Conditions.

City of Kalamazoo will approve progress payment invoices on account of the Contract Price on the basis of Contractor's Applications for Payment as approved by City of Kalamazoo on or about the 20 day of each month during construction as provided in Paragraphs below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the approved Schedule of Values.

For Cost of the Work: Progress payments on account of the Cost of the Work will be made:

Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as City of Kalamazoo may withhold, including but not limited to liquidated damages, in accordance with the Contract:

90 percent Cost of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by City of Kalamazoo and if the character and progress of the

Work have been satisfactory to City of Kalamazoo, then as long as the character and progress of the Work remain satisfactory to City of Kalamazoo, there will be no additional retainage; and

50 percent of cost of materials and equipment not incorporated in the Work but delivered, suitable stored and accompanied by documentation satisfactory to City of Kalamazoo as provided herein (with the balance being retainage).

Upon Substantial Completion, City of Kalamazoo will pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by City of Kalamazoo, and less 200 percent of Representative's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

For Contractor's fee: Progress payments on account of the Contractor's fee will be made as follows:

Payments prior to Substantial Completion will be in an amount equal to 100 percent of such fee earned to the date of the approved Application for Payment (less in each case payments previously made on account of such fee) based on the progress of the Work measured by the Schedule of Values established as provided in the General Conditions, and upon Substantial Completion in an amount sufficient to increase total payments to Contractor on account of his fee to 100 percent of Contractor's fee.

Upon final completion and acceptance of the Work, City of Kalamazoo will pay the remainder of the Contract Price as recommended by Designer and Representative.

42. PROGRESS PAYMENTS

Basis for Progress Payments: The Schedule of Values established as provided in herein will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to City of Kalamazoo. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

Mobilization for Contractor and any tier of subcontractor(s) shall be considered collectively and shall not exceed 10 percent of the Contract Price. Mobilization shall be those costs associated with the initiation of the project and site work, including but not limited to, transporting of personnel, equipment, materials, supplies, incidental items; establishment of the field offices, temporary facilities necessary for the project, bonds and insurances, submittal requirements, permits, field supervision, final cleanup and demobilization. Mobilization does not include such items as, contract negotiations and bid preparation.

Mobilization shall be included in the progress payments, in accordance with the schedule of values and unit prices. When the work, excluding mobilization and inventory, has progressed to an amount equal to five percent or more of the contract price, then an amount of not more than 50 percent of the mobilization cost will be considered for inclusion in the progress payment. Prior to the established five percent, City of Kalamazoo may consider payment on invoices for bonds and insurances and permits; this amount shall be subtracted for the total amount from mobilization.

Up to an additional 40 percent of the mobilization cost will be considered for inclusion in the progress payments once the work, excluding mobilization and inventory, has progressed to an amount equal to 50 percent of the Contract Price. The remaining mobilization payment will be paid as part of the final payment.

Costs for submittal requirements, field office and supervision, where identified separately in the schedule of values shall be considered for payment monthly. No adjustments shall be made for any contract time extensions.

Applications for Payments:

At least 20 days before the date established in the Agreement for each progress payment (but not more often than twice a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that City of Kalamazoo has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect City of Kalamazoo's interest therein, all of which must be satisfactory to City of Kalamazoo.

Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

Review of Applications:

City of Kalamazoo will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment, or return the Application to Contractor indicating in writing City of Kalamazoo's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

Recommendation of any payment requested in an Application for Payment will constitute a representation by City of Kalamazoo, based on City of Kalamazoo's, Designer's, and/or Representative's observations of the executed Work as an experienced and qualified design professional, and on City of Kalamazoo's, Designer's, and/or Representative's review of the Application for Payment and the accompanying data and schedules, that to the best of City of Kalamazoo's, Designer's, and/or Representative's knowledge, information and belief:

the Work has progressed to the point indicated;

the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, and any other qualifications stated in the recommendation); and

the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Designer's and/or Representative's responsibility to observe the Work.

By recommending any such payment Designer nor Representative will not thereby be deemed to have represented that:

inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned; or

there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by City of Kalamazoo or entitle City of Kalamazoo to withhold payment to Contractor.

Neither Designer's nor Representative's review of Contractor's Work for the purposes of recommending payments nor Designer's nor Representative's recommendation of any payment, including final payment, will impose responsibility on Designer's nor Representative's:

to supervise, direct, or control the Work, or

for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

to determine that title to any of the Work, materials, or equipment has passed to City of Kalamazoo free and clear of any Liens.

Designer and/or Representative may refuse to recommend the whole or any part of any payment if, in Designer's or Representative's opinion, it would be incorrect to make the representations to City of Kalamazoo stated herein.

Designer and/or Representative will recommend reductions in payment (set-offs) necessary in Designer's and/or Representative's opinion to protect City of Kalamazoo from loss because:

the Work is defective, requiring correction or replacement;

the Contract Price has been reduced by Change Orders;

City of Kalamazoo has been required to correct defective Work, or has accepted defective Work;

City of Kalamazoo has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

Designer and/or Representative has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

Reductions in Payment by City of Kalamazoo:

In addition to any reductions in payment (set-offs) recommended by Designer or Representative, City of Kalamazoo is entitled to impose a set-off against payment based on any of the following:

claims have been made against City of Kalamazoo on account of Contractor's conduct in the performance or furnishing of the Work, or City of Kalamazoo has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

Contractor has failed to provide and maintain required bonds or insurance;

City of Kalamazoo has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

City of Kalamazoo has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

the Work is defective, requiring correction or replacement;

City of Kalamazoo has been required to correct defective Work, or has accepted defective Work;

the Contract Price has been reduced by Change Orders;

an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to City of Kalamazoo to secure the satisfaction and discharge of such Liens;

there are other items entitling City of Kalamazoo to a set off against the amount recommended.

If City of Kalamazoo imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Designer or Representative, City of Kalamazoo will give Contractor immediate written notice (with a copy to Designer and Representative) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. City of Kalamazoo shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by City of Kalamazoo and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

Upon a subsequent determination that City of Kalamazoo's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due and subject to interest as provided herein.

43. LIQUIDATED DAMAGES

Contractor and City of Kalamazoo recognize that time is of the essence and that City of Kalamazoo will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in the Contract Documents, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by City of Kalamazoo if the Work is not completed on time. Accordingly, instead of requiring any such proof, City of Kalamazoo and Contractor agree that as liquidated damages for delay (but not as a penalty):

Substantial Completion: Contractor shall pay City of Kalamazoo $1,300.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in the Contract Documents for Substantial Completion until the Work is substantially complete.

Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay City of Kalamazoo $500.00 for each day that expires after such until the Work is completed and ready for final payment.

Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

44. SUPERVISION

Contractor shall employ an experienced Site Superintendent and/or Site Chief Foreperson on the Site at all times during performance of the Work.

Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in

accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

At all times during the progress of the Work, Contractor shall assign a competent Site Superintendent and/or Site Chief Foreperson who shall not be replaced without written notice to City of Kalamazoo, Designer, and Representative except under extraordinary circumstances

45. LABOR & WORKING HOURS

Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with City of Kalamazoo's written consent, which will not be unreasonably withheld.

Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the City of Kalamazoo for Designer's and/or Representative's services (including those of the Resident Project Representative, if any), City of Kalamazoo's Representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then City of Kalamazoo may impose a reasonable set-off against payments due.

46. MATERIALS, EQUIPMENT, & SERVICES

The material and equipment incorporated into the Work shall remain the property of the Contractor until a physical inspection of and beneficial usage of the material, equipment, and/or services is made and determined to be in full accord with the Contract Documents and of the highest quality and thereafter accepted to the satisfaction of City of Kalamazoo. In the event the material, equipment, and/or service supplied to City of Kalamazoo is found to be defective or does not conform to specifications, City of Kalamazoo reserves the right to cancel the Contract upon written notice to the Contractor and return the material and equipment to the Contractor at the Contractor's expense.

Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of City of Kalamazoo. If required by Designer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

47. "OR EQUALS" & SUBSTITUTIONS REQUESTS

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that City of Kalamazoo accept the use of other items of material or equipment, under the circumstances described below.

Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that City of Kalamazoo accept the use of other items of material or equipment under the circumstances described below.

Contractor shall provide all data in support of any proposed "or equal" or substitute item at Contractor's expense.

To the extent possible "or-equal" or substitution requests shall be made before commencement of related construction at the Site.

Designer will be allowed a reasonable time to evaluate each "or-equal" or substitution request, and to obtain comments and direction from City of Kalamazoo. Designer may require Contractor to furnish additional data about the proposed "or-equal" or substitute item. Designer will be the sole judge of acceptability. No "or-equal" or substitute item will be ordered, furnished, installed, or utilized until Designer's review is complete and Designer determines that the proposed item is an "or-equal" or an acceptable substitute pursuant to any City of Kalamazoo Contract Supplemental and/or Change Order procedures. Designer will advise Contractor in writing of "or-equal" acceptance. Designer will advise Contractor in writing accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Designer will advise Contractor in writing of any negative determination.

Neither approval nor denial of an "or-equal" request shall result in any increase in Contract Price or Contract Time. The Designer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

If Designer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Designer consider the proposed item as a substitute pursuant to paragraphs below.

If Designer approves the substitution request, Contractor shall submit a proposed Change Order for City of Kalamazoo approval and inclusion in the Contract. Upon City of Kalamazoo approval, Contractor shall proceed with the substitution. The Designer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

City of Kalamazoo may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute.

Designer will record Designer's costs in evaluating an "or-equal" or a substitute proposed or submitted by Contractor. Whether or not Designer approves an "or-equal" or a substitute so proposed or submitted by Contractor, Contractor shall reimburse City of Kalamazoo for the reasonable charges of Designer for evaluating each such proposed "or-equal" or substitute. Contractor shall also reimburse City of Kalamazoo for the reasonable charges of Designer for making changes in the Contract Documents (or in the provisions of any other direct contract with City of Kalamazoo) resulting from the acceptance of each proposed "or-equal" or substitute.

Contractor may challenge the scope of reimbursement costs imposed by timely submittal of a Change Proposal.

Contractor shall submit sufficient information as provided below to allow Designer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable "or-equal" or substitute therefor. Designer will not accept requests for review of proposed "or-equal" or substitute items of material or equipment from anyone other than Contractor.

The requirements for review by Designer will be as set forth below and as Designer may decide is appropriate under the circumstances.

Contractor shall make written application to Designer for review of a proposed "or-equal" or substitute item of material or equipment that Contractor seeks to furnish or use. The application:

shall certify that the "or-equal" proposed substitute item will:

perform adequately the functions and achieve the results called for by the general design,

be similar in substance to that specified, and

be suited to the same use as that specified.

will state:

the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with City of Kalamazoo for other work on the Project) to adapt the design to the proposed substitute item, and

whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

will identify:

if the application is for an "or-equal" or a substitute,

all variations of the proposed "or-equal" or substitute item from that specified, and

available engineering, sales, maintenance, repair, and replacement services.

shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change. "Or-equal" proposals shall not impact Contract Price nor Contract Time.

If Designer determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work nor increase in Cost or Contract Time will be required nor change in process function, design intent, nor life cycle cost, Designer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

in the exercise of reasonable judgment Designer determines that:

it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

it has a proven record of performance and availability of responsive service; and

it is not objectionable to City of Kalamazoo.

Contractor certifies that, if approved and incorporated into the Work:

there will be no increase in cost to the City of Kalamazoo or increase in Contract Times; and

it will conform substantially to that of the item named in the Contract Documents.

48. **CONCERNING SUBCONTRACTORS, SUPPLIERS, & OTHERS**

Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to City of Kalamazoo.

Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, City of Kalamazoo may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

Prior to entry into any binding subcontract or purchase order, Contractor shall submit to City of Kalamazoo the identity of the proposed Subcontractor or Supplier (unless City of Kalamazoo has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to City of Kalamazoo unless City of Kalamazoo raises a substantive, reasonable objection within five days.

City of Kalamazoo may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. City of Kalamazoo also may require Contractor to retain specific replacements; provided, however, that City of Kalamazoo may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by City of Kalamazoo, and City of Kalamazoo has accepted it (either in writing or by failing to make written objection thereto), then City of Kalamazoo may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

If City of Kalamazoo requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of City of Kalamazoo's requirement of replacement.

No acceptance by City of Kalamazoo of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of City of Kalamazoo to the completion of the Work in accordance with the Contract Documents.

On a monthly basis Contractor shall submit to City of Kalamazoo a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

Contractor shall be fully responsible to City of Kalamazoo, Designer, and Representative, for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with City of Kalamazoo, Designer, or Representative, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of City of Kalamazoo.

City of Kalamazoo may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

Nothing in the Contract Documents:

shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between City of Kalamazoo, Designer, or Representative and any such Subcontractor, Supplier, or other individual or entity; nor

shall create any obligation on the part of City of Kalamazoo, Designer, or Representative to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

49. PATENT FEES & ROYALTIES

Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work.

To the fullest extent permitted by Laws and Regulations, City of Kalamazoo shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless City of Kalamazoo, Designer, and Representative and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

50. PERMITS

Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. City of Kalamazoo shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). City of Kalamazoo shall pay all charges of utility owners for connections for providing permanent service to the Work.

51. LAWS AND REGULATIONS

Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither City of Kalamazoo, Designer, nor Representative shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless City of Kalamazoo, Designer, and Representative and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action.

City of Kalamazoo or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If City of Kalamazoo and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or City of Kalamazoo may initiate a Claim.

52. RECORD DOCUMENTS

Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to City of Kalamazoo, Designer, and Representative for reference. Upon completion of the Work, Contractor shall deliver these record documents to City of Kalamazoo.

53. SAFETY, PROTECTION, AND SECURITY

Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. No claim for damage, injury, or loss will be considered by City of Kalamazoo. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection and security to prevent damage, injury, or loss to:

all persons on the Site or who may be affected by the Work;

all the Work, materials and equipment to be incorporated therein, and tools and equipment necessary to perform the Work whether in storage on or off the Site; and

other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

Contractor shall be responsible to identify and determine the location of:

all persons on the Site or who may be affected by the Work;
all the Work, materials and equipment to be incorporated therein, and tools and equipment necessary to perform the Work whether in storage on or off the Site; and

other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

Contractor shall confine materials and equipment to be incorporated into the Work, and tools, equipment, and operations to those areas of the Site necessary for the completion of the Work, or as authorized by City of Kalamazoo.

Contractor shall comply with all applicable Laws, Regulations, Rules and Protocols relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify City of Kalamazoo; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

Contractor shall comply with the applicable requirements of City of Kalamazoo's safety protocols, including but not limited to those in response to the Covid-19 Pandemic.

Contractor shall inform City of Kalamazoo, Designer, and Representative of the specific requirements of Contractor's safety program with which City of Kalamazoo's, Designer's, and Representative's employees and representatives must comply while at the Site.

All damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of City of Kalamazoo, Designer, or Representative or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to City of Kalamazoo and Contractor that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

54. SAFETY REPRESENTATIVE

Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

55. HAZARD COMMUNICATION PROGRAMS

Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

56. EMERGENCIES

In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give City of Kalamazoo, Designer, and Representative prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If City of Kalamazoo, Designer, and Representative determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

57. SHOP DRAWINGS, SAMPLES, AND OTHER SUBMITTALS

Shop Drawing and Sample Submittal Requirements:

Before submitting a Shop Drawing or Sample, Contractor shall have:

reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

With each submittal, Contractor shall give specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted for review and approval of each such variation.

Submittal Procedures for Shop Drawings and Samples: Contractor shall submit Shop Drawings and Samples to Designer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Designer may require.

Shop Drawings:

Contractor shall submit the number of copies required in the Specifications.

Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Designer the services, materials, and equipment Contractor proposes to provide and to enable Designer to review the information.

Samples:

Contractor shall submit the number of Samples required in the Specifications.

Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Designer may require to enable Designer to review the submittal.

Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Designer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

Other Submittals: Contractor shall submit other submittals to Designer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
Designer's Review:

Designer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Designer. Designer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

Designer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

Designer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

Designer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of the Contract Documents and Designer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Designer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

Designer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of the Contract Documents.

Designer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

Neither Designer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of the Contract Documents.

Resubmittal Procedures:

Contractor shall make corrections required and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for on previous submittals.

Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Designer will record Designer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Designer's charges to City of Kalamazoo for such time. City of Kalamazoo may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Designer's charges to City of Kalamazoo for its review time, and City of Kalamazoo may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

58. CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

Contractor warrants and guarantees to City of Kalamazoo that all Work will be in accordance with the Contract Documents and will not be defective.

Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

normal wear and tear under normal usage.

Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

observations by Designer or Representative;

recommendation by Representative or payment by City of Kalamazoo of any progress or final payment;

the issuance of a certificate of Substantial Completion by Designer or any payment related thereto by City of Kalamazoo;

use or occupancy of the Work or any part thereof by City of Kalamazoo;

any review and approval of a Shop Drawing or Sample submittal;

the issuance of a notice of acceptability by Designer;

any inspection, test, or approval by others; or

any correction of defective Work by City of Kalamazoo.

If the Contract requires the Contractor to accept the assignment of a contract entered into by City of Kalamazoo, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to City of Kalamazoo for the Work described in the assigned contract.

The Contractor shall guarantee all of its Work for a period of one (1) year following the date of Final Completion of the Work and shall repair, replace or make good any materials or work which fail to function or perform or be found defective, without cost to the City

59. DELEGATION OF PROFESSIONAL DESIGN SERVICES

Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, City of Kalamazoo and Designer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Designer.

City of Kalamazoo and Designer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided City of Kalamazoo and Designer have specified to Contractor all performance and design criteria that such services must satisfy.

Pursuant to this paragraph, Designer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Designer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in the Contract Documents.

Contractor shall not be responsible for the adequacy of the performance or design criteria specified by City of Kalamazoo or Designer.

60. OTHER WORK

In addition to and apart from the Work under the Contract Documents, the City of Kalamazoo may perform other work at or adjacent to the Site. Such other work may be performed by City of Kalamazoo's employees, or through contracts between the City of Kalamazoo and third parties. City of Kalamazoo may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

If City of Kalamazoo performs other work at or adjacent to the Site with City of Kalamazoo's employees, or through contracts for such other work, then City of Kalamazoo shall give Contractor written notice thereof prior to starting any such other work. If City of Kalamazoo has advance information regarding the start of any utility work at or adjacent to the Site, City of Kalamazoo shall provide such information to Contractor.

Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and City of Kalamazoo, if City of Kalamazoo is performing other work with City of Kalamazoo's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with

such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of City of Kalamazoo and the others whose work will be affected.

If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Representative in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

61. COORDINATION

If City of Kalamazoo intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with City of Kalamazoo's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be provided to Contractor prior to the start of any such other work:

the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

an itemization of the specific matters to be covered by such authority and responsibility; and

the extent of such authority and responsibilities.

City of Kalamazoo shall have sole authority and responsibility for such coordination.

The Contractor shall coordinate and cooperate with all other contractors and City of Kalamazoo's employees who may be working at or adjacent to the Site in order to allow for the orderly progress of work.

The Contractor shall inform the City of Kalamazoo of any proposed Work which may interfere with the existing operations at or adjacent to the Site.

The Contractor shall coordinate and schedule all Work to accommodate the City of Kalamazoo's schedule and existing operations at or adjacent to the Site. In the event Contractor's schedule falls on weekends, nights or overtime, no additional compensation will be allowed. All Work shall be part of this Contract without regard to when it is completed.

Any and all Costs associated with coordination shall be included in the Contract.

62. LEGAL RELATIONSHIPS

If, in the course of performing other work at or adjacent to the Site for City of Kalamazoo, the City of Kalamazoo's employees, any other contractor working for City of Kalamazoo, or any utility owner for whom the City of Kalamazoo is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to City of Kalamazoo all Contractor's rights against such other contractor or utility owner with respect to the

damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of City of Kalamazoo, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then City of Kalamazoo may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the City of Kalamazoo's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

When City of Kalamazoo is performing other work at or adjacent to the Site with City of Kalamazoo's employees, Contractor shall be liable to City of Kalamazoo for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by City of Kalamazoo as a result of Contractor's failure to take reasonable and customary measures with respect to City of Kalamazoo's other work. In response to such damage, delay, disruption, or interference, City of Kalamazoo may impose a set-off against payments due to Contractor.

If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, City of Kalamazoo, Designer, or Representative, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless City of Kalamazoo, Designer, and Representative, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

63. AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order. Any amendment or supplement to the Contract will be subject to prior approval by the City of Kalamazoo Purchasing Agent. City of Kalamazoo Commission approval may also be required.

Change Orders:

If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

City of Kalamazoo and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Representative. Such an amendment shall be set forth in a Change Order.

Work Change Directives: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph(s) regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. City of Kalamazoo must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

Field Orders: Representative may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on City of Kalamazoo and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

64. OWNER-AUTHORIZED CHANGES IN THE WORK

Without invalidating the Contract and without notice to any surety, City of Kalamazoo may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Designer, to the extent the change involves the function (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if City of Kalamazoo and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

65. OWNER-REQUESTED ADDITIONS OF WORK

Prices for additional work requested by City of Kalamazoo are not contained herein as part of the Work. Should additional work be requested, compensation shall be made on the basis of price or prices to be mutually agreed upon. Such additional work shall not begin until an amendment or supplemental to the Contract has been approved.

66. UNAUTHORIZED CHANGES IN THE WORK

Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency or in the case of uncovering Work.

67. CHANGE OF CONTRACT PRICE

The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of the Contract Documents. Any Claim for an adjustment of Contract Price shall comply with the provisions of the Contract Documents.

An adjustment in the Contract Price will be determined as follows:

where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit); or

where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work plus a Contractor's fee for overhead and profit.

Contractor's Fee: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

a mutually acceptable fixed fee.

68. CHANGE OF CONTRACT TIMES

The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of the Contract Documents. Any Claim for an adjustment in the Contract Times shall comply with the provisions of the Contract Documents.

An adjustment of the Contract Times shall be subject to the limitations set forth in the Contract Documents, concerning delays in Contractor's progress.

69. CHANGE PROPOSALS

Contractor shall submit a Change Proposal to Representative to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by City of Kalamazoo concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

Procedures: Contractor shall submit each Change Proposal to Representative promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Representative and City of Kalamazoo within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Designer and Representative will advise City of Kalamazoo regarding the Change Proposal, and consider any comments or response from City of Kalamazoo regarding the Change Proposal.

Designer and Representative's Action: Designer and/or Representative will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to City of Kalamazoo and Contractor. If Designer or Representative does not take action on the Change Proposal within 30 days, then either City of Kalamazoo or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Designer's or Representative's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial.

Binding Decision: City of Kalamazoo's decision will be final and binding upon City of Kalamazoo and Contractor, unless Contractor appeals the decision by filing a Claim.

Resolution of Certain Change Proposals: If the Change Proposal does not involve the function (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Designer will notify the parties that the Designer is unable to resolve the Change Proposal.

70. EXECUTION OF CHANGE ORDERS

City of Kalamazoo and Contractor shall execute appropriate Change Orders covering:

changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

changes in Contract Price resulting from a City of Kalamazoo set-off, unless Contractor has duly contested such set-off;

changes in the Work which are: (a) ordered by City of Kalamazoo (b) required because of City of Kalamazoo's acceptance of defective Work or City of Kalamazoo's correction of defective Work, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the function (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under the Contract Documents.

If City of Kalamazoo or Contractor refuses to execute a Change Order that is required to be executed under the terms of Contract Documents, it shall be deemed to be of full force and effect, as if fully executed.

71. NOTIFICATION TO SURETY

If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

72. ACCESS TO WORK

City of Kalamazoo, Designer, Representative, their consultants and other representatives and personnel of City of Kalamazoo, independent testing laboratories, and authorities having jurisdiction shall have access and the right to the Site and the Work at reasonable times for their observation, inspection, and testing of any materials to be incorporated into or used in the completion of the Work. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

73. TESTS, INSPECTIONS, AND APPROVALS

Contractor shall give City of Kalamazoo timely notice of readiness of the Work (or specific parts thereof), materials, equipment or components for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

City of Kalamazoo will provide for materials and construction testing including but not limited to compaction of subbase and backfill material, concrete testing and asphalt testing. The cost of said testing shall be borne by City of Kalamazoo. Verification that testing required by the Contract has been completed on one phase of the Work prior to proceeding to the next phase is the responsibility of Contractor. In the event that the Work has proceeded without required testing, Contractor shall

insure that the required testing is obtained retroactively and shall provide access for testing as necessary at Contractor's expense.

If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof), materials, equipment or components specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish City of Kalamazoo the required certificates of inspection or approval.

Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to City of Kalamazoo;

to attain City of Kalamazoo's and Designer's acceptance of materials or equipment to be incorporated in the Work;

by manufacturers of equipment furnished under the Contract Documents;

for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to City of Kalamazoo and Designer.

If the Contract Documents require the Work (or part thereof), materials, equipment or components to be approved by City of Kalamazoo, Designer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

If any Work (or the work of others), materials, equipment, or components that are to be inspected, tested, or approved is covered by Contractor without written concurrence of City of Kalamazoo or Designer, Contractor shall, if requested by City of Kalamazoo or Designer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given City of Kalamazoo and Designer timely notice of Contractor's intention to cover the same and City of Kalamazoo and Designer had not acted with reasonable promptness in response to such notice.

Any Work (or the work of others), materials, equipment, or components which do not comply with Contract Specifications, MDOT, or State or Local codes may be rejected by the City of Kalamazoo.

City of Kalamazoo does not assume any responsibility for the contracted quality and standard of all materials, equipment, components or completed work furnished under this Contract.

74. DEFECTIVE WORK

Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.

Designer's Authority: Designer, with approval of City of Kalamazoo, has the authority to determine whether Work is defective, and to reject defective Work.

Notice of Defects: Prompt notice of all defective Work of which City of Kalamazoo or Designer has actual knowledge will be given to Contractor.

Correction, or Removal and Replacement: Promptly after receipt of written notice of defective Work, materials, or equipment, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Designer has rejected the defective Work, materials, or

equipment, remove it from the Project and replace it with Work, materials, or equipment that is not defective at no cost to City of Kalamazoo.

Preservation of Warranties: When correcting defective Work, Contractor shall take no action that would void or otherwise impair City of Kalamazoo's special warranty and guarantee, if any, on said Work.

Costs and Damages: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against City of Kalamazoo by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if City of Kalamazoo and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then City of Kalamazoo may impose a reasonable set-off against payments due.

75. ACCEPTANCE OF DEFECTIVE WORK

If, instead of requiring correction or removal and replacement of defective Work, City of Kalamazoo prefers to accept it, City of Kalamazoo may do so (subject, if such acceptance occurs prior to final payment, to Designer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to City of Kalamazoo's evaluation of and determination to accept such defective Work (such costs to be approved by Designer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then City of Kalamazoo may impose a reasonable set-off against payments due. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to City of Kalamazoo.

76. UNCOVERING WORK

City of Kalamazoo and Designer have the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

If any Work is covered contrary to the written request of City of Kalamazoo or Designer, then Contractor shall, if requested by City of Kalamazoo or Designer, uncover such Work for observation, and then replace the covering, all at Contractor's expense.

If City of Kalamazoo and Designer considers it necessary or advisable that covered Work be observed or inspected or tested, then Contractor, at City of Kalamazoo's and Designer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as City of Kalamazoo and Designer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the City of Kalamazoo shall be entitled to impose a reasonable set-off against payments due.

If the uncovered Work is not found to be defective, Contractor shall not be allowed an increase in the Contract Price nor an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction.

77. OWNER MAY STOP THE WORK

If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then City of Kalamazoo may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of City of Kalamazoo to stop the Work shall not give rise to any duty on the part of City of Kalamazoo to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

78. OWNER MAY CORRECT DEFECTIVE WORK

If Contractor fails within a reasonable time after written notice from City of Kalamazoo to correct defective Work, or to remove and replace rejected Work as required, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then City of Kalamazoo may, after seven days written notice to Contractor, correct or remedy any such deficiency.

In exercising the rights and remedies, City of Kalamazoo shall proceed expeditiously. In connection with such corrective or remedial action, City of Kalamazoo may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which City of Kalamazoo has paid Contractor but which are stored elsewhere. Contractor shall allow City of Kalamazoo, City of Kalamazoo's Representatives, agents and employees, City of Kalamazoo's other contractors, and Designer and Designer's consultants access to the Site to enable City of Kalamazoo to exercise the rights and remedies under this paragraph.

All claims, costs, losses, and damages incurred or sustained by City of Kalamazoo in exercising the rights and remedies will be charged against Contractor as set-offs against payments due. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by City of Kalamazoo of City of Kalamazoo's rights and remedies.

79. TEMPORARY UTILITIES

Temporary or construction water will be available on the Site. The Contractor must provide for drinking water.

Temporary toilets: To be supplied by the Contractor as may be necessary.

80. CONTRACTOR'S WARRANTY OF TITLE

Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to City of Kalamazoo free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by City of Kalamazoo.

81. SUBSTANTIAL COMPLETION

When Contractor considers the entire Work ready for its intended use Contractor shall notify City of Kalamazoo and Designer in writing that the entire Work is substantially complete and request that Designer issue a certificate of Substantial Completion. Contractor shall at the same time submit to City of Kalamazoo and Designer an initial draft of punch list items to be completed or corrected before final payment.

Promptly after Contractor's notification, City of Kalamazoo, Contractor, Representative, and Designer shall make an inspection of the Work to determine the status of completion. If City of Kalamazoo or Designer does not consider the Work substantially complete, Designer will notify Contractor in writing giving the reasons therefor.

If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Designer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to City of Kalamazoo. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then City of Kalamazoo may impose a reasonable set-off against payments due.

If Designer and City of Kalamazoo considers the Work substantially complete, Designer will, within 14 days after inspection, deliver to Contractor a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Designer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Contractor shall have seven days after receipt of the preliminary certificate during which to make written objection to Designer as to any provisions of the certificate or attached punch list. If Contractor does not object that the Work is substantially complete or submits objections, then Designer will, within 14 days of notification by Contractor, execute and deliver to City of Kalamazoo and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Designer and City of Kalamazoo believes justified after consideration of any objections from Contractor

If, after inspection of the Work, Designer and City of Kalamazoo concludes that the Work is not substantially complete, Designer will, within 14 days after inspection, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor.

At the time of receipt of the preliminary certificate of Substantial Completion, City of Kalamazoo and Contractor will confer regarding City of Kalamazoo's use or occupancy of the Work following Substantial Completion. Unless City of Kalamazoo and Contractor agree otherwise in writing, City of Kalamazoo shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon City of Kalamazoo's use or occupancy of the Work.

After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

City of Kalamazoo shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

82. PARTIAL USE OR OCCUPANCY

Prior to Substantial Completion of all the Work, City of Kalamazoo may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which City of Kalamazoo, Designer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by City of Kalamazoo for its intended

purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

At any time City of Kalamazoo may request in writing that Contractor permit City of Kalamazoo to use or occupy any such part of the Work that City of Kalamazoo and Designer believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, City of Kalamazoo, and Designer will follow the Substantial Completion procedures for that part of the Work.

At any time Contractor may notify City of Kalamazoo and Designer in writing that Contractor considers any such part of the Work substantially complete and request Designer to issue a certificate of Substantial Completion for that part of the Work.

Within a reasonable time after either such request, City of Kalamazoo, Contractor, Designer, and Representative shall make an inspection of that part of the Work to determine its status of completion. If Designer or City of Kalamazoo does not consider that part of the Work to be substantially complete, Designer will notify Contractor in writing giving the reasons therefor. If Designer and City of Kalamazoo considers that part of the Work to be substantially complete, the provisions herein will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

83. FINAL INSPECTION

Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Designer, City of Kalamazoo, and Representative will promptly make a final inspection with Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

84. FINAL PAYMENT

Application for Payment:

After Contractor has, in the opinion of Designer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in the Contract Documents), and other documents, Contractor may make application for final payment.

The final Application for Payment shall be accompanied (except as previously delivered) by:

all documentation called for in the Contract Documents;

consent of the surety, if any, to final payment;

satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to City of Kalamazoo free and clear of any Liens or other title defects, or will so pass upon final payment.

a list of all disputes that Contractor believes are unsettled; and

complete and legally effective releases or waivers (satisfactory to City of Kalamazoo) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

In lieu of the releases or waivers of Liens specified in Contract Documents and as approved by City of Kalamazoo, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected

with the Work for which City of Kalamazoo might in any way be responsible, or which might in any way result in liens or other burdens on City of Kalamazoo's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to City of Kalamazoo to indemnify City of Kalamazoo against any Lien, or City of Kalamazoo at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

Designer's and Representative's Review of Application and Acceptance:

If, on the basis of Designer's and Representative's observation of the Work during construction and final inspection, and Designer's and Representative's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Designer and Representative is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Designer will, within ten days after receipt of the final Application for Payment, indicate in writing Designer's and Representative's recommendation of final payment and present the Application for Payment to City of Kalamazoo for payment. Such recommendation shall account for any set-offs against payment that are necessary to protect City of Kalamazoo from loss for the reasons stated above with respect to progress payments. At the same time Designer will also give written notice to City of Kalamazoo and Contractor that the Work is acceptable. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

Completion of Work: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Designer's written recommendation of final payment.

Payment Becomes Due: Thirty days after the presentation to City of Kalamazoo of the final Invoice for Payment and accompanying documentation, the amount recommended by Designer and Representative (less any further sum City of Kalamazoo is entitled to set off, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by City of Kalamazoo to Contractor.

85. WAIVER OF CLAIMS

The making of final payment will not constitute a waiver by City of Kalamazoo of claims or rights against Contractor. City of Kalamazoo expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by City of Kalamazoo, or from Contractor's continuing obligations under the Contract Documents.

The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against City of Kalamazoo other than those pending matters that have been duly submitted or appealed under the provisions of the Contract Documents.

86. CORRECTION PERIOD

If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to City of Kalamazoo and in accordance with City of Kalamazoo's written instructions:

correct the defective repairs to the Site or such other adjacent areas;

correct such defective Work;

if the defective Work has been rejected by City of Kalamazoo, remove it from the Project and replace it with Work that is not defective, and

satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

If Contractor does not promptly comply with the terms of City of Kalamazoo's written instructions, or in an emergency where delay would cause serious risk of loss or damage, City of Kalamazoo may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

87. **OWNER MAY SUSPEND WORK**

At any time and without cause, City of Kalamazoo may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

88. **OWNER MAY TERMINATE FOR CAUSE**

The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

Contractor's repeated disregard of the authority of City of Kalamazoo, Designer, or Representative.

If one or more of the events identified herein occurs, then after giving Contractor (and any surety) ten days written notice that City of Kalamazoo is considering a declaration that Contractor is in default and termination of the contract, City of Kalamazoo may proceed to:

declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

enforce the rights available to City of Kalamazoo under any applicable performance bond.

Subject to the terms and operation of any applicable performance bond, if City of Kalamazoo has terminated the Contract for cause, City of Kalamazoo may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which City of Kalamazoo has paid Contractor but which are stored elsewhere, and complete the Work as City of Kalamazoo may deem expedient.

City of Kalamazoo may not proceed with termination of the Contract if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

If City of Kalamazoo proceeds, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by City of Kalamazoo, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to City of Kalamazoo. Such claims, costs, losses, and damages incurred by City of Kalamazoo will be reviewed by Designer and Representative as to their reasonableness and, when so approved by Designer and Representative, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, City of Kalamazoo shall not be required to obtain the lowest price for the Work performed.

Where Contractor's services have been so terminated by City of Kalamazoo, the termination will not affect any rights or remedies of City of Kalamazoo against Contractor then existing or which may thereafter accrue, or any rights or remedies of City of Kalamazoo against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by City of Kalamazoo will not release Contractor from liability.

If and to the extent that Contractor has provided a performance bond the provisions of that bond shall govern over any inconsistent provisions herein.

89. **OWNER MAY TERMINATE FOR CONVENIENCE**

Upon seven days written notice to Contractor, City of Kalamazoo may, without cause and without prejudice to any other right or remedy of City of Kalamazoo, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

90. CONTRACTOR MAY STOP WORK OR TERMINATE

If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by City of Kalamazoo or under an order of court or other public authority, or (2) Representative fails to act on any Application for Payment within 30 days after it is submitted, or (3) City of Kalamazoo fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to City of Kalamazoo, Designer, and Representative, and provided City of Kalamazoo, Designer, or Representative do not remedy such suspension or failure within that time, terminate the contract and recover from City of Kalamazoo payment on the same terms as provided herein.

In lieu of terminating the Contract and without prejudice to any other right or remedy, if Representative has failed to act on an Application for Payment within 30 days after it is submitted, or City of Kalamazoo has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to City of Kalamazoo, Designer, and Representative, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

91. GIVING NOTICE

Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

92. COMPUTATION OF TIMES

When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

93. CUMULATIVE REMEDIES

The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

94. LIMITATION OF DAMAGES

With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither City of Kalamazoo, Designer, nor Representative, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

95. **NO WAIVER**

A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

96. **SURVIVAL OF OBLIGATIONS**

All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

97. **CONTROLLING LAW**

This Contract is to be governed by the law of the state in which the Project is located.

98. **COMMUNICATIONS TO CONTRACTOR**

City of Kalamazoo shall issue all communications to Contractor.

99. **OWNER'S REPLACEMENT OF DESIGNER**

City of Kalamazoo may at its discretion appoint an engineer to replace Designer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Designer.

100. **OWNER'S REPLACEMENT OF REPRESENTATIVE**

City of Kalamazoo may at its discretion appoint a representative to replace Representative, provided Contractor makes no reasonable objection to the replacement representative. The replacement representative's status under the Contract Documents shall be that of the former Representative.

101. **OWNER'S FURNISHMENT DATA**

City of Kalamazoo shall promptly furnish the data required of City of Kalamazoo under the Contract Documents.

102. **LIMITATIONS ON OWNER'S RESPONSIBILITIES**

The City of Kalamazoo shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. City of Kalamazoo will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

103. **SAFETY PROGRAMS**

While at the Site, City of Kalamazoo's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which City of Kalamazoo has been informed.

City of Kalamazoo shall furnish copies of any applicable City of Kalamazoo safety programs to Contractor.

104. **DESIGNER'S & REPRESENTATIVE'S STATUS DURING CONSTRUCTION**

Designer may be City of Kalamazoo's representative during the construction period. The duties and responsibilities and the limitations of authority of Designer as City of Kalamazoo's representative during construction are set forth in the Contract.

Designer will make visits to the Site at intervals appropriate to the various stages of construction, as Designer or City of Kalamazoo deems necessary, to observe, as an experienced and qualified design professional, the progress and the quality of the executed Work of Contractor and if such Work is proceeding in compliance with the Contract Documents. Firm will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of such Work. During such visits and on the basis of Site observations, Firm will keep City of Kalamazoo informed of the progress of the Work and will inform City of Kalamazoo of known material defects and deficiencies in such Work.

Designer's visits and observations are subject to all the limitations on Designer's authority and responsibility set forth in the Contract Documents. Particularly, but without limitation, during or as a result of Designer's visits or observations of Contractor's Work, Designer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of such Work.

Based on the Firm's visits to the Site and on the basis of Site observations, as an experienced and qualified design professional, and on review of applications for payment and the accompanying data and schedules, the Firm will determine the amount owing to the Contractor and recommend, in writing, payments to Contractor in such amount; such recommendations of payment will constitute a representation to the City of Kalamazoo, based on such observations and review that the Work has progressed to the point indicated, that to the best of the Firm's knowledge, information and believe, the quality of such Work is in compliance with the Contract Documents (subject to the evaluation of such work as a functioning Project upon Substantial Completion, the results of any subsequent rests called for in the Contract Documents, and to any qualifications stated in its recommendation); but by recommending any payment, the Firm will not be thereby deemed to have represented that it has made an examination to ascertain how, or for what purpose, Contractor has used the monies paid on account of the Contract Price, or that title to any of the Work, materials, or equipment has passed the City of Kalamazoo free and clear of any lien, claims, security interests or encumbrances, or that Contractor has completed their work exactly in accordance with the Contract Documents.

Firm will conduct an inspection to determine if the Project is Substantially Complete and a final inspection to determine if the Work has been completed in accordance with the Contract Documents, and if Contractor has fulfilled all of Contractor's obligations thereunder so that Firm may recommend, in writing, final payment Contractor and may give written notice to the City of Kalamazoo and the Contractor that the Work is acceptable (subject to any conditions therein expressed).

If City of Kalamazoo and Designer have agreed that Designer will furnish a Resident Project Representative to represent Designer at the Site and assist Designer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided below, and limitations on the responsibilities thereof will be as provided in below.

The Resident Project Representative (RPR) will be Designer's representative at the Site, will act as directed by and under the supervision of Designer, and will confer with Designer regarding RPR's actions.

General: RPR's dealings in matters pertaining to the Work in general shall be with Designer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with City of Kalamazoo only with the knowledge of and under the direction of Designer.

Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Designer concerning acceptability.

Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.

Liaison:

Serve as Designer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

Assist Designer in serving as City of Kalamazoo's liaison with Contractor when Contractor's operations affect City of Kalamazoo's on-Site operations.

Assist in obtaining from City of Kalamazoo additional details or information, when required for proper execution of the Work.

Interpretation of Contract Documents: Report to Designer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Designer.

Shop Drawings and Samples:

Record date of receipt of Samples and Contractor-approved Shop Drawings.

Receive Samples which are furnished at the Site by Contractor, and notify Designer of availability of Samples for examination.

Advise Designer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Designer.

Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Designer. Transmit to Contractor in writing decisions as issued by Designer.

Review of Work and Rejection of Defective Work:

Conduct on-Site observations of Contractor's work in progress to assist Designer in determining if the Work is in general proceeding in accordance with the Contract Documents.

Report to Designer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Designer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

Inspections, Tests, and System Start-ups:

Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate City of Kalamazoo's personnel, and that Contractor maintains adequate records thereof.

Observe, record, and report to Designer appropriate details relative to the test procedures and systems start-ups.

Records:

Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Designer.

Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

Maintain records for use in preparing Project documentation.

Reports:

Furnish to Designer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

Draft and recommend to Designer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

Immediately notify Designer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Designer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Designer for review and forwarding to City of Kalamazoo prior to payment for that part of the Work.

Completion:

Participate in Designer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.

Participate in Designer's final visit to the Site to determine completion of the Work, in the company of City of Kalamazoo and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.

Observe whether all items on the final list have been completed or corrected and make recommendations to Designer concerning acceptance and issuance of the notice of acceptability of the work.

The RPR shall not:

Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

Exceed limitations of Designer's authority as set forth in the Contract Documents.

Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.

Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of City of Kalamazoo or Contractor.

Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Designer.

Accept Shop Drawing or Sample submittals from anyone other than Contractor.

Authorize City of Kalamazoo to occupy the Project in whole or in part.

Designer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Designer will not show partiality to City of Kalamazoo or Contractor, and will not be liable to City of Kalamazoo, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

Neither Designer's authority or responsibility, nor any decision made by Designer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Designer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Designer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

Designer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Designer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

Designer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

Designer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

The limitations upon authority and responsibility set forth shall also apply to the Resident Project Representative, if any.

While at the Site, Designer's employees and representatives will comply with the specific applicable requirements of City of Kalamazoo's and Contractor's safety programs (if any) of which Designer has been informed.

SECTION VI
TERMS AND CONDITIONS

1. AWARD OF CONTRACT

A. This contract will be awarded to that responsible bidder whose bid, conforming to this solicitation, will be most advantageous to the City, price and other factors considered. The City reserves the right to accept or reject any or all bids and waive informalities and minor irregularities in bids received. Other factors include, as an example but not limited to, delivery time, conformance to specifications, incidental costs such as demurrage and deposits, etc.

Notification of award will be in writing by the Purchasing Agent. Upon notification, the Contractor shall submit to the Purchasing Division all required insurance certificates (if required) and such other documentation as may be requested or required hereunder. Upon their receipt and subsequent approval by the City, the Purchasing Agent will forward to the Contractor a written **NOTICE TO PROCEED**. Work shall **NOT** be started until such **NOTICE TO PROCEED** is received by the Contractor.

B. Unilateral changes in bid prices by the bidder shall not be allowed. However, the City, at its sole option, reserves the right to negotiate with bidders in the event of, but not limited to:

1) No bids received;
2) A single bid being received; or
3) Prices quoted are over budget and/or unreasonable.

2. COMPLETE CONTRACT

This bid document together with its addenda, amendments, attachments and modifications, when executed, becomes the complete contract between the parties hereto, and no verbal or oral promises or representations made in conjunction with the negotiation of this contract shall be binding on either party.

3. SUBCONTRACTORS – NON-ASSIGNMENT

Bidders shall state in writing any and all sub-contractors to be associated with this bid, including the type of work to be performed. The Contractor shall cooperate with the City of Kalamazoo in meeting its commitments and goals with regard to maximum utilization of minority and women-owned business enterprises.

The Contractor hereby agrees and understands that the contract resulting from this solicitation shall not be transferred, assigned or sublet without prior written consent of the City of Kalamazoo.

4. TAXES

The City of Kalamazoo is exempt from all federal excise tax and state sales and use taxes.

5. INVOICING

All original invoice(s) will be sent to the Financial Services Division, 241 W. South Street, Kalamazoo, MI 49007 or via email at apinvoice@kalamazoocity.org. The Finance Division processes payments after receipt of an original invoice from the Contractor and approval by the department. The City of Kalamazoo's policy is to pay invoice(s) within 30 days from the receipt of the original invoice, if the services or supplies are satisfactory and the proper paperwork and procedures have been followed**. In order to guarantee payment to the vendor on a timely basis, the vendor needs to receive a purchase order number before supplying the City of Kalamazoo with goods or services.** All original, and copies of original invoice(s), will clearly state which purchase order they are being billed against.

The City of Kalamazoo is a government municipality and therefore is tax exempt from all sales tax.

The vendor is responsible for supplying the Finance Division with a copy of their W9 if they are providing a service to the City of Kalamazoo.

6. PAYMENTS

Upon issuance of certificates of Payment by the Architect/Engineer for labor and material incorporated in the work and the materials suitably stored at the site payment shall be made up to ninety (90%) percent of the value thereof.

When the cumulative total of payment is equal to fifty (50%) percent of the contract sum, subsequent payments will be made in the full amount for labor and material certified by the Architect/Engineer.

The amount retained shall be held until final acceptance of the work, receipt of all payrolls, releases, and waiver of liens.

7. CHANGES AND/OR CONTRACT MODIFICATIONS

The City reserves the right to increase or decrease quantities, service or requirements, or make any changes necessary at any time during the term of this contract, or any negotiated extension thereof. Price adjustments due to any of the foregoing changes shall be negotiated and mutually agreed upon by the Contractor and the City.

Changes of any nature after contract award which reflect an increase or decrease in requirements or costs shall not be permitted without prior approval by the Purchasing Agent. City Commission approval may also be required.

ANY CHANGES PERFORMED IN ADVANCE OF PURCHASING AGENT APPROVAL, MAY BE SUBJECT TO DENIAL AND NON-PAYMENT.

8. LAWS, ORDINANCES AND REGULATIONS

The Contractor shall keep himself/herself fully informed of all local, state and federal laws, ordinances and regulations in any manner affecting those engaged or employed in the work and the equipment used. Contractor and/or employees shall, at all times, serve and comply with such laws, ordinances and regulations.

Any permits, licenses, certificates or fees required for the performance of the work shall be obtained and paid for by the Contractor.

This contract shall be governed by the laws of the State of Michigan.

9. RIGHT TO AUDIT

The City or its designee shall be entitled to audit all of the Contractor's records, and shall be allowed to interview any of the Contractor's employees, throughout the term of this contract and for a period of three years after final payment or longer if required by law to the extent necessary to adequately permit evaluation and verification of:

A. Contractor compliance with contract requirements,
B. Compliance with provisions for pricing change orders, invoices or claims submitted by the Contractor or any of his payees.

10. HOLD HARMLESS

If the negligent acts or omissions of the Contractor/Vendor or its employees, agents or officers, cause injury to person or property, the Contractor/Vendor shall indemnify and save harmless the City of Kalamazoo, its agents, officials, and employees against all claims, judgments, losses, damages, demands, and payments of any kind to persons or property to the extent occasioned from any claim or demand arising therefrom.

11. DEFAULT

The City may at any time, by written notice to the Contractor, terminate this contract and the Contractor's right to proceed with the work, for just cause, which shall include, but is not limited to the following:

A. Failure to provide insurance and bonds (when called for), in the exact amounts and within the time specified or any extension thereof.

B. Failure to make delivery of the supplies, or to perform the services within the time specified herein, or any extension thereof.

C. The unauthorized substitution of articles for those bid and specified.

D. Failure to make progress if such failure endangers performance of the contract in accordance with its terms.

E. Failure to perform in compliance with any provision of the contract.

F. **Standard of Performance** - Contractor guarantees the performance of the commodities, goods or services rendered herein in accordance with the accepted standards of the industry or industries concerned herein, except that if this specification calls for higher standards, then such higher standards shall be provided.

Upon notice by the City of Contractor's failure to comply with such standards or to otherwise be in default of this contract in any manner following the Notice to Proceed, Contractor shall immediately remedy said defective performance in a manner acceptable to the City. Should Contractor fail to immediately correct said defective performance, said failure shall be considered a breach of this contract and grounds for termination of the same by the City.

In the event of any breach of this contract by Contractor, Contractor shall pay any cost to the City caused by said breach including but not limited to the replacement cost of such goods or services with another Contractor.

The City reserves the right to withhold any or all payments until any defects in performance have been satisfactorily corrected.

In the event the Contractor is in breach of this contract in any manner, and such breach has not been satisfactorily corrected, the City may bar the Contractor from being awarded any future City contracts.

G. All remedies available to the City herein are cumulative and the election of one remedy by the City shall not be a waiver of any other remedy available to the City.

12. TERMINATION OF CONTRACT

The City may, at any time and without cause, suspend the work of this contract for a period of not more than ninety days after providing notice in writing to the Contractor. The Contractor shall be allowed an adjustment in the contract price or an extension of the contract times, or both, directly attributable to the suspension if Contractor makes an approved claim.

The City may, without prejudice to any other right or remedy of the City, and with or without cause, terminate the contract by giving seven days written notice to the Contractor. In such case the Contractor shall be paid, without duplication, for the following items:

A. Completed and acceptable work executed in accordance with the contract documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such work;

B. Expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the contract documents in connection with uncompleted work, plus fair and reasonable sums for overhead and profit on such expenses;

C. All documented claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

D. Reasonable expenses directly attributable to termination.

The Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

13. INDEPENDENT CONTRACTOR

At all times, the Contractor, any of his/her employees, or his/her sub-contractors and their subsequent employees shall be considered independent contractors and not as City employees. The Contractor shall exercise all supervisory control and general control over all workers' duties, payment of wages to Contractor's employees and the right to hire, fire and discipline their employees and workers. As an independent contractor, payment under this contract shall not be subject to any withholding for tax, social security or other purposes, nor shall the Contractor or his/her employees be entitled to sick leave, pension benefit, vacation, medical benefits, life insurance or workers' unemployment compensation or the like.

14. PROJECT SUPERVISOR

The Contractor shall employ an individual to act as Project Supervisor. The Project Supervisor shall be available to the Contractor's workers and the Project Manager at all times by use of a beeper or other reliable means. The Project Supervisor shall prepare daily work plans for the employees, monitor employee performance, attendance and punctuality; and work closely with the City's Project Manager in assuring contract compliance.

15. MEETINGS

The Contractor and/or Project Supervisor shall be available to meet with the Department Head or Project Manager at a mutually agreeable time to discuss problems, issues or concerns relative to the contract. Either party may call a meeting at any time. When such a request for a meeting is made, the meeting date shall, in no case exceed five (5) working days after the request; and, if in the sole opinion of the Department Head, the severity of the circumstance warrants, no more than one (1) working day.

16. INSPECTION OF WORK SITE

Before submitting bids or quotes for work, the Contractor shall be responsible for examining the work site and satisfying himself/herself as to the existing conditions under which he/she will be obligated to operate, or that in any way affects the work under this contract. No allowance shall be made subsequently, in behalf of the Contractor, for any negligence on his/her part.

17. CONTRACT PERIOD, EXTENSIONS, CANCELLATION

A. The contract shall be in effect for the term stated in the specifications.

B. The City may opt to extend this contract upon mutual agreement of both parties. The number of extensions shall be limited to that stated in the specifications.

C. The City may, from time to time, find it necessary to continue this contract on a month-to-month basis only, not to exceed a six (6) month period. Such month-to-month extended periods shall be by mutual agreement of both parties, with all provisions of the original contract or any extension thereof remaining in full force and effect.

D. All contracts, extensions and cost increases are subject to availability of funds and the approval of the City Commission (if required).

E. The City reserves the right to cancel the contract due to non-appropriation of funds by the City with thirty (30) days written notice.

F. Either party may terminate the contract (or any extension thereof) without cause at the end of any twelve (12) month term by giving written notice of such intent at least 60 days prior to the end of said twelve (12) month term.

G. All notices are in effect commencing with the date of mailing. Written notices may be delivered in person or sent by First Class mail; faxed or emailed to the last known address.

H. If cancellation is for default of contract due to non-performance, the contract may be canceled at any time (see Item 11, DEFAULT)

APPENDIX A
NON-DISCRIMINATION CLAUSE FOR ALL CITY OF KALAMAZOO CONTRACTS

The Contractor agrees to comply with the Federal Civil Rights Act of 1964 as amended; the Federal Civil Rights Act of 1991 as amended; the Americans With Disabilities Act of 1990 as amended; the Elliott-Larson Civil Rights Act, Act. No. 453, Public Act of 1976 as amended; the Michigan Handicappers Civil Rights Act, Act No. 220, Public Act of 1976 as amended, City Ordinance 1856 and all other applicable Federal and State laws. The Contractor agrees as follows:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, sex, age, height, weight, marital status, physical or mental disability, family status, sexual orientation or gender identity that is unrelated to the individual's ability to perform the duties of the particular job or position. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer, recruitment advertising, layoff or termination; rates of pay or other forms of compensations; and selection for training, including apprenticeship.

2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, sex, age, height, weight, marital status, physical or mental disability family status, sexual orientation or gender identity that is unrelated to the individual's ability to perform the duties of the particular job or position.

3. If requested by the City, the Contractor shall furnish information regarding practices, policies and programs and employment statistics for the Contractor and subcontractors. The Contractor and subcontractors shall permit access to all books, records and accounts regarding employment practices by agents and representatives of the City duly charged with investigative duties to assure compliance with this clause.

4. Breach of the covenants herein may be regarded as a material breach of the contract or purchasing agreement as provided in the Elliott-Larsen Civil Rights Act and City Ordinance 1856.

5. The Contractor will include or incorporate by reference the provisions of the foregoing paragraphs 1 through 4 in every subcontract or purchase order unless exempted by the rules, regulations or orders of the Michigan Civil Rights Commission* and will provide in every subcontract or purchase order that said provision will be binding upon each subcontractor or seller.

6. The Contractor will not preclude a person with a criminal conviction from being considered for employment unless otherwise precluded by federal or state law. (for contracts over $25,000)

   The Elliott-Larson Civil Rights Act, Sec. 202 of Act. No. 453 of 1976 reads in part as follows:

   Sec. 202. (1) An employer shall not:

   (a) Fail or refuse to hire, or recruit, or discharge or otherwise discriminate against an individual with respect to employment, compensation, or a term condition or privilege of employment because of religion, race, color, national origin, age, sex, height, weight or marital status.

   (b) Limit, segregate or classify an employee or applicant for employment in a way which deprives or tends to deprive the employee or applicant of an employment opportunity or otherwise adversely affects the status of an employee or applicant because of religion, race, color, national origin, age, sex, height, weight or marital status.

   (c) Segregate, classify or otherwise discriminate against a person on the basis of sex with respect to a term, condition or privilege of employment, including a benefit plan or system.

* Except for contracts entered into with parties employing less than three employees.
1-2010

APPENDIX B - PREVAILING WAGES

Prevailing wages are applicable to this contract, therefore, rates will apply as follows:

(XX) Project is funded by City of Kalamazoo monies and is estimated to be in excess of $100,000.00. The applicable prevailing wage rates are attached.

Specifications for projects in which the City of Kalamazoo is party for construction, alterations and/or repair including painting and decorating of public buildings or public works in or for the City of Kalamazoo and which requires or involves the employment of mechanics and/or laborers shall contain the following provisions stating the minimum wages to be paid the various classes of laborers and mechanics for the project. Prevailing wage rates determined by the U.S. Department of Labor under Davis Bacon and related acts will be used for City of Kalamazoo construction projects.

By the incorporation of prevailing wage rates within this specification, the City of Kalamazoo stipulates that:

- ✓ Contractor or his/her subcontractor shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less than once a week and without subsequent deduction or rebate on any account the full amount, accrued at the time of payment, computed at wage rates as incorporated herein regardless of any contractual relationship which may be alleged to exist between the contractor or subcontractor and such laborers and mechanics;
- ✓ The scale of wages to be paid shall be posted by the contractor in a prominent and easily accessible place at the site of the work;
- ✓ The Prime Contractor and all subcontractors shall submit weekly certified payrolls documenting the hours worked and wages paid by work classification. **NOTE: Contactor shall not include Social Security numbers of employees on certified payrolls.**
- ✓ There may be withheld from the contractor's accrued payments the amount considered necessary by the City's Contracting Official to pay to laborers and mechanics employed by the contractor or any subcontractor on the work for the difference between the rates of wages required by the contract and the rates of wages received by such laborers and mechanics except those amounts properly deducted or refunded pursuant to the terms of the Davis-Bacon Act (USC, Title 40, Sec. 276a) and interpretations thereof.

Special Note: The City's requirements as it relates to prevailing wages **includes a meeting with the City's Purchasing Agent prior to starting work and the submission of weekly certified payrolls by prime contractors and all subcontractors.** The City will monitor certified payrolls, work progress, and conduct interviews with the mechanics and labors employed directly upon the site during the duration of the contract Please contact the Purchasing Department at (269) 337-8020 if you have any questions regarding prevailing wage provision.

The overtime pay to which a laborer or mechanic is entitled under this contract shall be that overtime pay to which he/she is entitled by any agreement made with the contractor or subcontractor or by any applicable provision of law; but in no event shall such amount be less than the prevailing wage in the Kalamazoo community for such overtime.
Revised 4-08

PREVAILING WAGES

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Bid Reference #: 91359-003.0

February 2022

"General Decision Number: MI20220087 02/18/2022

Superseded General Decision Number: MI20210087

State: Michigan

Construction Type: Building

County: Kalamazoo County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that aresubject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022, Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least $15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022, Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least $11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

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

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

Modification Number	Publication Date
0	01/07/2022
1	02/18/2022

ASBE0047-002 07/01/2021

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 33.77	18.18

BOIL0169-001 01/01/2021

	Rates	Fringes

BOILERMAKER.....$ 35.95 34.52

BRMI0009-031 08/01/2020

	Rates	Fringes
BRICKLAYER	$ 31.01	20.36
TILE FINISHER	$ 23.17	13.79
TILE SETTER	$ 24.23	15.56

CARP0525-013 06/01/2021

	Rates	Fringes
CARPENTER (Including Acoustical Ceiling Installation, Drywall Hanging, Form Work, Metal Stud Installation & Scaffold Builder)	$ 25.94	20.59

CARP1102-001 06/01/2019

	Rates	Fringes
MILLWRIGHT	$ 28.59	24.79

ELEC0131-001 06/01/2021

	Rates	Fringes
ELECTRICIAN		
Excludes Low Voltage Wiring.	$ 36.61	7.95+27%

ENGI0324-002 06/01/2021

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 42.38	24.85
GROUP 2	$ 39.08	24.85
GROUP 3	$ 36.43	24.85
GROUP 4	$ 34.72	24.85
GROUP 5	$ 34.72	24.85
GROUP 6	$ 28.86	24.85
GROUP 7	$ 26.38	24.85

FOOTNOTES:

Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate.
Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Backhoe/Excavator/Trackhoe; Crane; Concrete Pump; Grader/Blade; Highlift; Hoist; Loader; Roller; Scraper; Stiff Leg Derrick; Trencher

GROUP 4: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 5: Boom Truck (non-swinging)

GROUP 6: Fork Truck (20' lift and under for masonry work)

GROUP 7: Oiler

IRON0340-002 06/19/2017

	Rates	Fringes
IRONWORKER, REINFORCING AND STRUCTURAL	$ 24.43	24.67

LABO0355-022 06/01/2021

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Brick; Mason Tender - Cement/Concrete; Sandblaster	$ 24.90	12.95
Pipelayer	$ 20.34	12.85

PAIN0312-002 06/01/2020

	Rates	Fringes
PAINTER: Brush and Roller	$ 23.74	13.35
PAINTER: Drywall Finishing/Taping	$ 23.74	13.35
PAINTER: Spray	$ 25.22	13.47

PLAS0016-003 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 22.31	12.83

PLUM0357-001 07/01/2020

Excluding Fort Custer

	Rates	Fringes
PIPEFITTER, Includes HVAC Pipe and Unit Installation	$ 35.20	22.35
PLUMBER, Excludes HVAC Pipe and Unit Installation	$ 35.20	22.35

ROOF0070-002 06/01/2021

	Rates	Fringes
ROOFER	$ 29.09	16.53

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* SFMI0669-001 04/01/2021

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 36.97	24.56

SHEE0007-010 05/01/2018

	Rates	Fringes
SHEET METAL WORKER (HVAC Duct Installation Only)	$ 32.61	19.66

SUMI2011-012 02/01/2011

	Rates	Fringes
IRONWORKER, ORNAMENTAL	$ 18.48	7.93
LABORER: Landscape & Irrigation	$ 10.38	0.50
OPERATOR: Bulldozer	$ 19.68	6.64
OPERATOR: Tractor	$ 19.10	8.48
SHEET METAL WORKER, Excludes HVAC Duct and Unit Installation	$ 23.59	5.66
TRUCK DRIVER: Dump Truck	$ 17.26	11.42
TRUCK DRIVER: Lowboy Truck	$ 14.50	0.44
TRUCK DRIVER: Tractor Haul Truck	$ 13.57	1.18

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

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

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after

award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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

Union Rate Identifiers

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

Survey Rate Identifiers

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

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

Union Average Rate Identifiers

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determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

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

WAGE DETERMINATION APPEALS PROCESS

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

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* a Wage and Hour Division letter setting forth a position on a wage determination matter
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Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

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

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END OF GENERAL DECISION"

"General Decision Number: MI20220061 01/07/2022

Superseded General Decision Number: MI20210061

State: Michigan

Construction Type: Heavy

County: Kalamazoo County in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022, Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least $15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022, Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least $11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

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

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

Modification Number	Publication Date
0	01/07/2022

* CARP0525-006 06/01/2021

	Rates	Fringes
CARPENTER, Includes Form Work	$ 25.94	20.59

ELEC0131-006 06/01/2021

	Rates	Fringes

ELECTRICIAN.....$ 36.61 7.95+27%

ENGI0325-009 09/01/2021

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 35.92	24.85
GROUP 2	$ 31.03	24.85
GROUP 3	$ 30.53	24.85
GROUP 4	$ 30.25	24.85

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/ Excavator, Boring Machine, Bulldozer, Crane, Grader/ Blade, Loader, Roller, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non- powered type boom)

GROUP 4: Broom/ Sweeper, Fork Truck, Tractor, Bobcat/ Skid Steer /Skid Loader

---

ENGI0326-025 06/01/2021

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 42.38	24.85
GROUP 2	$ 39.08	24.85
GROUP 3	$ 36.43	24.85
GROUP 4	$ 34.72	24.85
GROUP 5	$ 34.72	24.85
GROUP 6	$ 28.86	24.85
GROUP 7	$ 26.38	24.85

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Backhoe/Excavator; Boring Machine; Bulldozer; Crane; Grader/Blade; Loader; Roller; Scraper; Tractor; Trencher

GROUP 4: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 5: Boom truck (non-swinging)

GROUP 6: Fork Truck (20' lift and under for masonry work)

GROUP 7: Oiler

FOOTNOTES:
Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate.

Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

IRON0340-004 06/19/2017

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING	$ 24.43	24.67

LABO0334-011 09/01/2018

SCOPE OF WORK:
OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General	$ 20.97	12.85
(2) Mason Tender-Cement/Concrete	$ 21.10	12.85
(4) Grade Checker	$ 21.28	12.85
(5) Pipelayer	$ 21.40	12.85

LABO0355-010 06/01/2021

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Cement/Concrete	$ 24.90	12.95
Pipelayer	$ 20.34	12.85

PAIN0312-014 06/12/2014

	Rates	Fringes
PAINTER		
Brush & Roller	$ 21.75	11.94
Spray	$ 22.75	11.94

PLAS0016-020 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 22.31	12.83

PLUM0333-026 06/01/2020

Fort Custer

	Rates	Fringes
PLUMBER	$ 38.79	23.08

PLUM0357-012 07/01/2020

Excluding Fort Custer

	Rates	Fringes
PLUMBER	$ 35.20	22.35

TEAM0007-011 06/01/2020

	Rates	Fringes
TRUCK DRIVER		
Lowboy/Semi-Trailer Truck	$ 28.05	.50 + a+b
Tractor Haul Truck	$ 27.80	.50 + a+b

FOOTNOTE:
a. $470.70 per week.
b. $68.70 daily.

SUMI2010-059 11/09/2010

	Rates	Fringes
LABORER: Landscape	$ 12.25	0.00
TRUCK DRIVER: Dump Truck	$ 18.00	6.43
TRUCK DRIVER: Off the Road Truck	$ 20.82	3.69

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

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

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses

(29CFR 5.5 (a) (1) (ii)).

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END OF GENERAL DECISION"

ATTACHMENT A
Geotechnical Evaluation Report

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Bid Reference #: 91359-003.0

February 2022

GEOTECHNICAL EVALUATION REPORT

KWRP BIOFILTRATION ODOR CONTROL
KALAMAZOO, MICHIGAN

SME Project No. 085267.00
August 12, 2021

SME

3301 Tech Circle Drive
Kalamazoo, MI 49008-5611

T (269) 323-3555

www.sme-usa.com

August 12, 2021

Mr. Ryan Stoughton, PE
Assistant City Engineer
City of Kalamazoo
Department of Public Services - Wastewater Division
1415 Harrison Street
Kalamazoo, Michigan 49007

Via E-mail: stoughtonr@kalamazoocity.org (PDF file)

RE: Geotechnical Evaluation
KWRP Biofiltration Odor Control
Kalamazoo, Michigan
SME Project No. 085267.00

Dear Mr. Stoughton:

We have completed our geotechnical evaluation for the subject project. This report presents the results of our observations and analyses, and our geotechnical engineering recommendations based on the information disclosed by the borings.

We appreciate this opportunity to be of service. If you have questions or require additional information, please contact me.

Sincerely,

SME

Aaron J. Reed, PE
Project Manager / Senior Project Engineer

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APPENDIX A

BORING LOCATION DIAGRAM (FIGURE NO. 1)
BORING LOG TERMINOLOGY
BORING LOGS (B1 THROUGH B5)
OBSERVATION WELL LOG (OW5)

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT
GENERAL COMMENTS
LABORATORY TESTING PROCEDURES

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1. INTRODUCTION

This report presents the results of the geotechnical evaluation performed by SME for the proposed Kalamazoo Water Reclamation Plant (KWRP) Biofiltration Odor Control project located at the KWRP in Kalamazoo, Michigan. SME conducted services in general accordance with the scope outlined in SME Proposal No. P03059.20, dated October 1, 2020, and Change Order No. 1 dated August 12, 2021. The City of Kalamazoo (City)authorized our services for this evaluation.

To assist with our evaluation and the preparation of this report, the following project documents were made available to SME by Jones & Henry Engineers, Ltd (J&H), the project civil engineer:

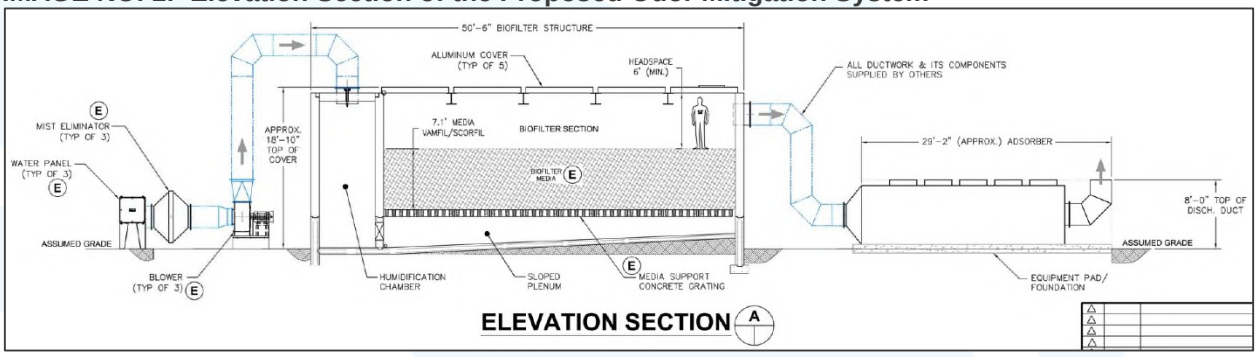
- A PDF file of a drawing titled “General Arrangement, 3 Bay X 15 (Total) Covers, Built-in-place Concrete Biofilter”, Drawing No. M-1, dated May 18, 2021, and prepared by Envirogen Technologies for the “Biological Foul Air Treatment” project.
- A PDF file of the “City of Kalamazoo Biological Foul Air Mitigation System Technical Proposal” document, dated May 26, 2021, prepared by Envirogen Technologies.
- CAD file “2672002 – Kalamazoo WWTP.dwg” containing a drawing titled “Topographic Survey for the City of Kalamazoo Water Reclamation Facility”, dated December 4, 2020, and prepared by Summit Surveying, Inc. (drawing hereafter referred to as “Topographic Survey”).

1.1 SITE CONDITIONS AND PROJECT DESCRIPTION

The project site is situated at the KWRP. More specifically, the site is located within the area of an existing asphalt parking lot in the southeast corner of the plant. Site grades within the project area generally range from about elevation 761 feet to 763 feet. The location of the site is depicted on the Location Map inset on the Boring Location Diagram (Figure No. 1) included in Appendix A.

The project will consist of the construction of a single story, slab-on-grade, steel-framed building. The proposed building will measure 61 feet by 50.5 feet. Air will be pushed into the building via three inlet blowers located on one side of the building. Air will be forced through a biofiltration media inside the building before exiting through one of three carbon absorbers located on the exterior of the building, opposite of the inlet blowers. Image No. 1 below depicts the elevation section of the proposed building.

IMAGE NO. 1: Elevation Section of the Proposed Odor Mitigation System



Structural loads of the building were not provided to SME at the time of our evaluation. However, based on our review of the available system information, we anticipate the proposed building will be supported on a continuous perimeter foundation, and exterior equipment will be supported on isolated mat foundations. We anticipate structural loads will include maximum wall loads of 6 kips per linear foot and maximum mat foundations contact pressures of 1,000 pounds per square-foot (psf).

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2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

SME completed five borings (B1 through B5) at the site on October 12 and 13, 2020. The borings each extended between 30 and 35 feet below the existing ground surface for a total of 160 feet of drilling. The approximate locations of the borings are depicted on Figure No. 1.

SME and J&H determined the planned number, depths, and locations of the borings based on our understanding of the project. SME staked the borings in the field prior to the field exploration by referencing and measuring from existing site features. SME estimated the existing surface elevations at the as-drilled boring locations to the nearest 1-foot using topographic data shown on the referenced Topographic Survey.

The borings were drilled using a truck-mounted rotary drill and were advanced to the sampling depths using continuous-flight, hollow-stem augers. The borings included soil sampling based upon the Split-Barrel Sampling procedure. Recovered split-barrel samples were sealed in glass jars. Groundwater observations were recorded during and immediately after completion of each boring. Excluding boring B5, the boreholes were backfilled with auger cuttings after completion and collection of groundwater observations. Therefore, long-term groundwater levels were not obtained from borings B1 through B4. The borehole at boring B3, located with an existing pavement area, was capped with asphalt cold patch after backfilling.

Groundwater observation well OW5 was constructed in the borehole of boring B5. The observation well was constructed with a 2-inch-diameter PVC well screen with 0.010-inch slot openings, and 2-inch-diameter PVC well casing. The well was finished with a stick-up riser pipe capped with a locking expandable pressure cap placed at the top of the riser pipe. SME measured the elevation of the top of the riser pipe to the nearest 0.01-feet by using a laser level and referencing Control Point No. 5 shown on the referenced Topographic Survey.

Soil samples recovered from the field exploration were returned to the SME laboratory for further observation and testing.

SME obtained a supplemental groundwater elevation reading from observation well OW5 on August 5, 2021. The groundwater level in the observation well was measured using an electronic water level indicator, which measures the depth to the water surface in the well from the top of the riser pipe.

2.2 LABORATORY TESTING

The laboratory testing program consisted of performing visual soil classification on recovered samples in general accordance with ASTM D-2488. A moisture content and hand penetrometer test were performed on a portion of a recovered cohesive sample from boring B4. Moisture content tests were performed on samples that visually appeared organic in nature. Loss-on-ignition (LOI) tests were also performed on selected samples to evaluate the organic matter content of the sample. The Laboratory Testing Procedures in Appendix B provides descriptions of laboratory tests referenced above. Based on the laboratory testing, we assigned a group symbol to the various soil strata encountered based on the Unified Soil Classification System (USCS).

Upon completion of the laboratory testing, boring logs were prepared that include information on materials encountered, penetration resistances, and pertinent field observations made during the drilling operations, along with the results of the laboratory tests. Each log also includes the existing ground surface elevation as estimated by SME. The boring logs are included in Appendix A. Explanations of symbols and terms used on the boring logs are provided on the Boring Log Terminology sheet included in Appendix A.

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SME prepared an observation well log for observation well OW5 to document the details of the well construction. The observation well log is included in Appendix A. The soil conditions depicted on the observation well log are based on the soil conditions encountered at boring B5.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

The soil conditions encountered at the borings generally consisted of sand fill overlying buried topsoil and peat, underlain by natural sands. A generalized summary of the materials encountered at the boring locations, beginning at the existing ground surface and proceeding downward, is provided below.

Stratum 1: Surface Materials. About 10-inches of surficial topsoil was encountered at boring B1 and about 5-1/2 inches of asphalt pavement was encountered at boring B3.

Stratum 2: Sand Fill. Sand fill was encountered below the surface materials at borings B1 and B3, and beginning at the ground surface at borings B2, B4, and B5. The sand fill extended to depths ranging from about 6 feet to 9.5 feet below the existing ground surface, or to between about elevations 755 feet and 752.5 feet. Asphalt and wood pieces were observed within the fill at borings B2 and B5. The sand fill was encountered in a loose to very dense condition.

Stratum 3: Buried Topsoil and Peat. Buried topsoil was encountered below the sand fill at borings B1, B2, B3, and B5 and extended to depths ranging from about 8 to 12 feet below the existing ground surface, or to between about elevations 753 feet and 750 feet. The buried topsoil was found to have organic contents ranging from 7.2 to 10.1 percent. Peat was encountered below the sand fill at boring B4 and extended to a depth of about 13 feet below the existing ground surface, or to about elevation 749 feet. The peat exhibited a moisture content of 114 percent and an organic matter content of 40 percent.

Stratum 4: Natural Sands. Natural sands were encountered below the overlying buried topsoil and peat and extended to the explored depths of the borings. The natural sands were in a very loose to dense condition, with Standard Penetration Test (SPT) resistances (N-values) of 3 to 41 blows per foot of penetration (bpf). However, most of the natural sands were encountered in a medium dense condition.

The soil profile described above and included on the appended boring logs is a generalized description of the conditions encountered. The stratification depths described above and shown on the boring logs are intended to indicate a zone of transition from one soil type to another. They are not intended to show exact depths of change from one soil type to another. The soil descriptions are based on visual classification of the soils encountered. Soil conditions may vary between or away from the boring locations from those conditions noted on the logs. Please refer to the boring logs for the soil conditions at the specific boring locations.

Thickness measurements of surficial materials reported on the boring logs should be considered approximate since mixing of these materials with the underlying subgrade can occur while advancing the augers, and it is difficult to measure the thickness of surface materials in small-diameter boreholes. Therefore, if accurate thickness measurements are required for inclusion in bid documents or for quantity estimates, additional evaluations should be performed, such as shallow test pits in topsoil or gravel areas, and pavement cores in pavement areas.

3.2 GROUNDWATER CONDITIONS

Groundwater was observed at the borings during drilling and after extraction of the augers at the depths and elevations shown in Table 1 below.

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TABLE 1: SUMMARY OF GROUNDWATER OBSERVATIONS FROM BORINGS

BORING NUMBER	DURING DRILLING		AT END OF BORING	
	DEPTH (FEET)	ELEVATION (FEET)	DEPTH (FEET)	ELEVATION (FEET)
B1	7.0	754.0	7.3	753.7
B2	9.0	752.0	9.0	752.0
B3	10.5	751.5	10.3	751.7
B4	13.0	749.0	10.4	751.6
B5	12.0	750	Observation Well OW5 was constructed in the borehole upon completion	

The surface of the Kalamazoo River according to the referenced Topographic Survey was shown as being just below elevation 753 feet. On August 5, 2021, the groundwater at observation well OW5 was measured to be at elevation 753.01 feet.

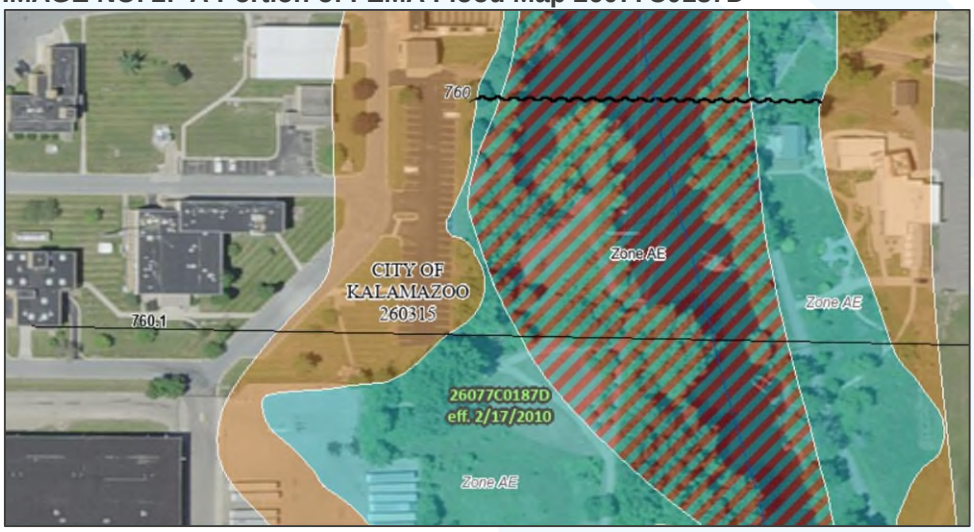
In general, we expect the site groundwater levels will be relatively consistent with (located within a foot or so) the water surface elevation of the Kalamazoo River. Hydrostatic groundwater levels and groundwater seepage rates encountered in excavations should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, the surface water level of the Kalamazoo River, and other factors. The groundwater levels indicated on the boring logs, and presented in this section, represent conditions at the time the readings were taken. The groundwater levels at the time of construction, and at times in the future, should be expected to vary.

4. ANALYSIS AND RECOMMENDATIONS

4.1 FLOODPLAIN CONSIDERATIONS

According to the Federal Emergency Management Agency (FEMA) Flood Map 26077C0187D (effective February 17, 2010), the entirety of the project site is located with the 500-year floodplain as shown by the orange shaded region on Image No. 2 below. The FEMA Flood map shows the project area as having a 100-year flood elevation of 760.1 feet.

IMAGE NO. 2: A Portion of FEMA Flood Map 26077C0187D



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Since the project site is relatively flat, we anticipate site grading required for the project will mostly be related to filling to elevate the proposed improvements suitably above the FEMA 100- and 500-year floodplains that extend onto the project site. We recommend the building FFE be established at least 1 foot above the 100-year flood elevation. The FFE should also be established a suitable distance above the 500-year flood elevation. If grades are raised within a floodplain area (i.e., if filling is performed in a floodplain), there is typically a requirement to compensate for floodplain volume lost because of fill placement in the floodplain. Therefore, we recommend the project civil engineer determine the specific floodplain elevations and associated boundaries on this site, and these boundaries and elevations should be indicated on the project site plan.

4.2 BURIED TOPSOIL AND ORGANIC SOIL CONSIDERATIONS

Peat and buried topsoil containing significant organic matter were encountered below the sand fill and extended to depths ranging from about 8 to 13 feet below the existing ground surface at the boring locations. The buried topsoil strata (encountered at borings B1, B2, B3, and B5) ranged in thickness from about 2 to 2.5 feet, while the peat stratum encountered at boring B4 was about 3.3 feet. Organic soils such as these, especially the peat encountered at this site, will compress or settle at a relatively rapid initial rate when subjected to new loading (as a result of primary compression), such as from the construction of overlying improvements or the placement of new fill. Even in the absence of new loading, organic soils tend to settle very slowly over time as a result of secondary (long-term) compression. Therefore, structures situated on or above organic soils are at risk of experiencing excessive total and differential settlements over time. Based on the soil conditions encountered, we do not recommend the proposed structures be supported on or above the existing organic soils.

Two common options for constructing structures in areas of organic soils include removing (i.e., undercutting) the organic soils and replacing them with a non-compressible material (such as granular engineered fill or crushed aggregates), or supporting the structures on deep foundations (e.g., piles or piers) that transfer loads to more competent soils below the organics. For this site, we believe both options would be feasible. On July 8, 2021, SME attended a project team meeting, which included representatives from both J&H and the City, to discuss both options with the project team. During this meeting, the City decided they would like to proceed with the option of undercutting the organic soils within the project area to eliminate the risk of long term settlement for this project, but also for site improvements that may be constructed within the undercut area in the future. Since the undercutting operations for this option extend over a relatively large area, this option is sometimes referred to as a “mass undercut”. The following report sections provide recommendations for removing the organic soils from the project area within a mass undercut.

4.3 SITE PREPARATION AND EARTHWORK

4.3.1 GENERAL SITE SUBGRADE PREPARATION

The proposed building and equipment areas, and areas to receive engineered fill, should be cleared and stripped of existing topsoil, vegetation, trees, tree roots, pavements, and other deleterious materials. We recommend the clearing and stripping extend a minimum of 15 feet beyond the outer edges of the proposed building and equipment areas and areas to receive engineered fill.

The existing fill, buried topsoil, and peat are not suitable for support of foundations and floor slabs and should be undercut from the entire footprint of the proposed structures (building and equipment areas) depicted on the “System Plan” view of the referenced “General Arrangement” drawing. The undercuts to remove the existing fill, buried topsoil, and peat should extend laterally a minimum of 10 feet beyond the outside edge of the proposed system footprint (i.e., building and equipment areas). Undercuts to remove existing fill, buried topsoil, and peat should be extended through the organic soils to expose suitable natural sands below. The information from the borings can be used to estimate the anticipated undercut depths. However, undercut depths to remove existing fill, buried topsoil, and peat could vary between or away from the boring locations.

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Based on our experience with similar subsurface conditions where groundwater is expected at or near the bottom of the undercut, we recommend using a sequential undercutting procedure where the undercutting and backfilling is performed within a relatively small area instead of opening up the entire excavation area all at one time. For this approach, the excavation associated with the undercut is performed by initially excavating the overall undercut area to a few feet above the site groundwater levels. After this pre-cut is completed, the remainder of the undercutting if performed sequentially by undercutting the unsuitable soils in a small area to expose suitable underlying soils, stabilizing the bottom of the excavation using crushed aggregates, and then backfilling the excavation with crushed aggregate to above the groundwater level. This procedure is repeated while working only in a small section or area of the overall excavation at one time.

We recommend SME verify suitable removal of the existing fill, buried topsoil, and peat, and that SME verify suitable natural soils are exposed at the base of each sequential zone of undercut excavation. After verification of suitable removal of unsuitable soils by SME, the base of each undercut section should be immediately stabilized and backfilled to above the groundwater level using a well-graded, coarse crushed aggregate or crushed concrete, ranging from about 1 to 3 inches in nominal size and containing no more than 7 percent passing the No. 200 sieve. The coarse, crushed material should be tamped or charged into the exposed subgrade using the excavator bucket or static rolled until it is stable. We recommend backfilling with the coarse, crushed material to at least 1-foot above the groundwater level. The coarse crushed material should be choked with at least 6 inches of a dense-graded aggregate such as MDOT 21AA. The purpose of the choke layer is to mitigate the potential for migration of overlying granular fill into the voids of the coarse material. A heavy, non-woven geotextile fabric placed on the surface of the coarse, crushed material may be used in lieu of the dense-graded aggregate.

We anticipate groundwater control using pumps in slotted casings or using multiple, closely-spaced sump pits with pumps will be necessary during the undercutting and backfilling operations, until the excavation is backfilled to above the site groundwater level. Test pits could be performed at the site prior to construction to verify groundwater levels and seepage rates into excavations. Groundwater levels could also be monitored using observation well OW5. This information can then be used to assist the contractor in planning for control of groundwater seepage during construction.

As indicated above, the contractor must be prepared to immediately stabilize the resulting subgrade at the base of the undercuts by charging the base of the undercut excavation with the recommended coarse, crushed aggregate or crushed concrete. Therefore, the coarse, crushed material must be present at the site and ready for placement in the excavations immediately after the presence of suitable natural subgrade soils are visually verified by SME. The base of the undercuts are expected to be wet, and conventional vibratory methods for compaction of fill in the undercuts could result in subgrade disturbance or “quick” conditions. Therefore, the coarse, crushed material should be tamped into the exposed subgrade using the excavator bucket, or worked into the subgrade by static rolling until the subgrade becomes stable. Vibratory compaction equipment can be used once the surface of the engineered fill is suitably above the groundwater.

After stripping and clearing operations are completed, after cuts are made to design subgrade levels, and after the recommended undercuts are completed and backfilled, we expect sand fill will be exposed outside of undercut areas. Prior to placing new fill on the subgrade in these areas, we recommend the exposed surface be compacted with vibratory compaction equipment. In general, we recommend the vibratory compaction in the exposed subgrade areas be performed to achieve a minimum of 95 percent of the Modified Proctor dry density in the upper 12 inches of the exposed subgrade.

After compaction of the exposed subgrade, engineered fill may be placed on the prepared subgrade to establish final subgrade elevations. See Section 4.3.3 of this report for recommendations related to engineered fill materials and placement and compaction requirements.

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4.3.2 SUBGRADE PREPARATION FOR GRADE SLABS

After completion of undercutting and backfilling in the building and equipment areas as outlined above, we anticipate the final subgrade for the grade slab of the proposed building will consist of engineered fill placed over the recommended aggregate layers described above in Section 4.3.1. These soils are considered suitable for support of the floor slab, provided the subgrade is properly prepared as described in Section 4.3.1, and any engineered fill is properly placed and compacted as discussed in Section 4.3.3.

Prior to concrete placement for floor slabs, the building pad subgrade should be observed and tested by SME to identify any areas that were disturbed during construction activities and to verify subgrade conditions are suitable for floor slab support. This re-evaluation of the subgrade could consist of a thorough proofroll where access is available for proofrolling equipment, or testing the exposed subgrade using density in-place meters or other hand-operated equipment, such as hand augers and cone penetrometers. Unsuitable subgrade areas indicated by SME should be improved in-place (recompacted), or removed and replaced with engineered fill.

We recommend the top 6 inches of floor slab subgrades consist of an approved granular material. The purpose of the granular material is to serve as a leveling surface for construction of the slab, and a moisture capillary break between the slab and the underlying soils. MDOT Class II sand is recommended for use as the granular level material and moisture capillary break. Alternatively, an approved aggregate material, such as MDOT 21AA dense-graded aggregate, may be used in lieu of the granular material. The use of an aggregate material can provide for a more stable working platform for construction of the slab and improved protection to subgrade disturbance. The thickness of aggregate needed to provide a stable subgrade will depend on the condition of the subgrade soils during construction, the specific aggregate used, and the type of construction equipment to traffic the prepared subgrade. We recommend the backfilling of the mass undercut excavation within the building and equipment areas be performed such that the backfill material in the upper 6 inches meets the recommendations for the leveling surface and moisture capillary break. The granular leveling material, or the aggregate material if used, should be compacted per the requirements in Section 4.3.3 of this report.

A vapor retarder should be provided below floor slabs that are to receive an impermeable floor finish/seal or a floor covering which would retard vapor transmission. The location of the vapor retarder (relative to the subbase) should be determined by the design Architect/Engineer based on the intended floor usage, planned finishes, and ACI recommendations.

Floor slabs should be separated by isolation joints from structural walls and columns to permit relative movement. A minimum of 6 inches of engineered fill should be placed between the bottom of the slab and the top of the shallow foundation below.

The slab-on-grade subgrade soils should be protected from frost action during winter construction. Frozen soils must be thawed and compacted, or removed and replaced prior to slab-on-grade construction.

4.3.3 ENGINEERED FILL REQUIREMENTS

Any fill placed within structural areas, including utility trench backfill, should be an approved material, free of frozen soil, excessive organics, over-sized materials, or other deleterious materials. Fill placed in structural areas should be compacted to a minimum of 95 percent of the maximum dry density determined in accordance with the Modified Proctor test. Sand fill should be compacted with a smooth drum vibratory roller or vibratory plate compactors, including either walk-behind types, or plate compactors mounted on a backhoe or excavator (e.g., a Ho-Pac®). Lifts of fill should not exceed the thickness that can be completely compacted to the specified density by the equipment being used for compaction.

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The existing sand fill at the boring locations containing debris is generally not considered suitable for re-use as engineered fill. However, portions of the existing fill that can be successfully segregated from unsuitable portions of the existing fill may be considered for re-use as engineered fill, provided the material meets the requirements in the previous paragraph. SME can assist the contractor with identifying suitable materials for re-use as engineered fill. Material meeting MDOT Class II requirements should be used as fill where drainage is required. Engineered fill used in the upper 6 inches of the final subgrade below floor slabs, and engineered fill used as drainage backfill, should be tested to verify the material meets MDOT Class II requirements.

The existing clayey and silty sand fill (with USCS group symbols of "SC" and "SM") will be difficult to compact in confined areas, such as in utility trenches and undercut excavations, where smaller, walk-behind type compaction equipment may be used. Clayey and silty soils should not be used as engineered fill where drainage is required and should only be used as engineered fill in open areas where compaction is achieved with large equipment and where moisture conditioning is feasible. During wetter/colder periods of the year when moisture conditioning of the clayey and silty soils will likely not be feasible, we expect it will be necessary to import greater quantities of granular fill meeting MDOT Class II granular material requirements to the site and waste the clayey and silty soils in non-structural areas of the site, or dispose of these soils off-site.

Soils containing appreciable amounts of silt or clay can be difficult to compact in confined areas, such as in utility trenches or around foundations. In confined areas, in areas where drainage is required, and in other areas where compaction is accomplished primarily by hand-operated equipment, an approved granular material, such as MDOT Class II sand, should be used as backfill. Thinner lifts will be required to achieve suitable compaction of the backfill in areas where smaller, walk-behind type compactors are used. Based on the boring information, the cleaner natural sands with USCS designations of "SP" and possibly "SP-SM" should meet MDOT Class II gradational requirements. However, gradational tests should be performed during construction to verify on-site sands planned for reuse in drainage areas meet MDOT Class II requirements.

Portions of the existing sand fill excavated from the mass undercut may be considered for re-use as engineered fill to backfill the mass undercut above the surface of aggregate choke layer. The feasibility of re-using the existing fill will depend on the ability of the contractor to segregate the cleaner sands (with USCS designations of "SP" or "SP-SM") from sands contained more fines such as silt and clay, and whether there is room to temporarily stockpile these materials prior to re-use and/or to spread these soils out for moisture conditioning if needed. We anticipate a net import of engineered fill will be required to backfill the mass undercut. We recommend material imported for use as engineered fill in the mass undercut meet MDOT Class II requirements.

4.4 FOUNDATIONS

Shallow spread foundations are recommended for support of the building and shallow mat foundations are recommended for support of equipment. Foundations must bear on engineered fill used to backfill the mass undercut described in Section 4.3.1. We recommend the use of a maximum net allowable soil bearing pressure of 3,000 pounds per square-foot (psf) for design of isolated (column), and continuous (wall) spread foundations, and mat foundations bearing on these soils. If a vertical modulus of subgrade reaction is needed for design of mat foundations, we recommend using 150 kips per cubic-foot (kcf). The recommended subgrade modulus is based on empirical relationships between soil type and plate load tests performed using a 12-inch square bearing plate at the ground surface. Suitable bearing soils are anticipated beginning just below the ground surface once the backfilling of the mass undercut is completed.

To verify suitable subgrade is exposed in foundation areas, we recommend SME evaluate foundation subgrades during construction. Once each foundation area is exposed, SME should observe and test the subgrade to verify suitable soils are encountered or improvements are performed, as needed. In general, we anticipate overly loose sands (if any) or disturbed soils may be improved by compaction in-place. For large mat foundations that may be open for several days while reinforcing steel is tied and placed, a

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protective layer of dense-graded aggregate such as MDOT 21AA should be considered for placement on the exposed subgrade right after the subgrade is tested and approved. The purpose of the aggregate is to protect the subgrade from disturbance. We anticipate a thickness of protective aggregate of 6 inches will be suitable for this purpose.

Foundations along exterior walls and foundations in any unheated areas of the building should be situated a minimum of 42 inches below final site grade for protection against frost action during normal winters. Interior foundations in heated areas can be constructed at shallower levels on suitable soils just below the floor slab. However, the foundations and proposed bearing soils should be protected from freezing during construction if work occurs in the winter months.

Foundation excavations are anticipated to expose sandy soils that are susceptible to sloughing and caving. Therefore, we anticipate foundation excavations will need to be sloped back and the sides of foundations vertically formed. The sides of foundations must be constructed in a vertical manner to reduce the risk of frost movements associated with foundation sides that "mushroom out" near the top. Caved soils should be removed from the foundation bearing surfaces before placing concrete. Foundation concrete should be placed as soon as foundation excavations have been completed, and the design bearing pressure verified to reduce the potential for disturbance of the foundation subgrade.

For bearing capacity and settlement considerations, continuous (wall) foundations should have a minimum width of 18 inches and isolated spread (column) foundations should have a minimum dimension of 30 inches. In cases of relatively light structural loads, the minimum foundation size criteria may govern the size of the foundation, and not the allowable soil bearing pressure.

Total settlements for shallow spread foundations bearing on engineered fill and crushed aggregates placed over suitable natural sands are estimated to be 1 inch or less, and differential settlements between similarly loaded foundations are estimated to be less than one-half of the total settlement. For mat foundations, we anticipate total settlements will be ½-inch or less. The settlement estimates provided are based on the boring information, the design maximum net allowable soil bearing pressure, the estimated design structural loads or contact pressures, our experience with similar structures and soil conditions, and field verification of the foundation bearing soils by SME.

4.5 SEISMIC SITE CLASS

Based on the subsurface information obtained from the borings to a maximum depth of 35 feet, on the undercutting of existing buried topsoil and peat, and on our geotechnical experience in the project area, seismic site Class D applies to this site in accordance with the 2015 Michigan Building Code (MBC), referencing Table 20.3-1 in ASCE Standard ASCE/SEI 7-10.

4.6 CONSTRUCTION CONSIDERATIONS

Groundwater seepage into the excavation to remove the existing fill, buried topsoil, and peat should be anticipated. The aggregate materials recommended in the report sections above are intended in part to facilitate removal of groundwater accumulations from excavations during construction. We anticipate accumulations of groundwater seepage can be generally be controlled using conventional sump pit and pumping procedures, although the use of multiple, closely-spaced sumps may be required, or using pumps in slotted casings. In excavations where groundwater accumulates and where aggregate is not already present, a working surface of coarse crushed aggregate or crushed concrete may be required to protect the exposed subgrade.

The contractor must provide a safely sloped excavation or an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, appropriate shoring must be used to resist the extra pressure due to the superimposed loads.

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The contractor must take precautions to protect nearby existing structures, adjacent roadways, sidewalks, and utilities during undercutting operations and construction of the proposed system. Care must be exercised during the excavating and compacting operations so that excessive vibrations do not cause settlement of nearby existing structures, roadways, sidewalks, and utilities, and to avoid undermining existing utilities during excavation operations. Where sufficient space or setback from existing utilities or structures exist, we anticipate the sides of the excavation can be temporarily sloped back in accordance with applicable regulations. However, depending on the final location of the system, lateral constraints in at least some portions of the site (e.g., existing underground utilities, driveway, buildings, and roadways) may not allow the utilization of excavations with sloped, and/or benched sidewalls. Therefore, a temporary earth retention system (TERS) may be required to support the excavation sidewalls where site constraints do not allow for sloped excavation sidewalls. Dewatering to control groundwater (if encountered) could be necessary at some locations in conjunction with the use of a TERS.

Steel sheet piles or other approved earth retention methods (such as a soldier pile and lagging system) should be used where excavations are close to critical or sensitive structures or utilities. The design of the earth retention and any required bracing is typically performed by the contractor's engineer and will be based on economy as well as geometric and ground conditions. A TERS must be designed by a licensed engineer. In some cases, additional geotechnical information could be required for design of the TERS. Consideration should be given to how installation of sheeting or other earth retention systems may affect nearby structures and underground utilities. Trench boxes can be used to support excavation sidewalls, but only in areas where soil movements of the magnitude that is common to the use of trench boxes would not adversely impact nearby structures. Please contact SME for more information regarding TERS design services. If vibration from the installation or extraction of sheeting is anticipated to have a negative impact on infrastructure, vibration monitoring systems should be implemented, or alternative shoring methods should be considered.

The contractor should remove ponded surface water and prevent run-off from reaching foundation excavations and areas of prepared subgrade. We recommend the contractor establish positive surface drainage at the onset of construction to mitigate the potential for subgrade disturbance. To reduce the potential of subgrade disturbance across the site, construction traffic should be restricted to dedicated areas of the site, and not be allowed to randomly traffic areas of prepared subgrade.

The silty and clayey sand fill encountered below the surficial pavement and topsoil and at the ground surface is susceptible to disturbance when trafficked, especially when these soils become wet. If the subgrade is disturbed, it will be necessary to disc, aerate, and recompact the disturbed silty and clayey subgrade, or to remove and replace the disturbed soils with engineered fill, crushed aggregate, or crushed concrete. Moisture conditioning (discing, aerating, and drying) of silty and clayey soils will likely not be feasible during seasonally cold and wet times of the year, resulting in a need for additional imported fill meeting MDOT Class II granular material requirements, and additional spoils that must be disposed of on-site or exported, if the work is performed between the late fall and early spring seasons. Performing site work during the drier summer months should reduce, but not eliminate, the potential for subgrade disturbance and the need for improvement of the subgrade. The existing site pavements may also be considered for use as a construction platform to reduce the risk of subgrade disturbance, and the pavement removed sequentially as the earthwork proceeds.

We anticipate some or most of the existing fill that is undercut will not be able to be re-used as engineered fill. Ideally, excess cut materials or soil materials that are unsuitable for re-use as engineered fill should be kept on-site and bermed up in greenbelt areas. However, it may be necessary to remove these materials from the property if there is no greenbelt area available. Before soils are removed from the site, we recommend these materials be further characterized to evaluate the potential need for special handling, transport, and disposal. The project environmental consultant should assist with the characterization of these soils and the evaluation of potential handling and disposal requirements.

Based on the potentially variable depths of existing sand fill, buried topsoil, and peat, the undercuts to remove these materials could vary across the site. We recommend the bid documents require prospective contractors to include unit prices for excavating existing sand fill, buried topsoil, and peat, and

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replacing the fill with engineered fill. Pricing should also be provided for re-use of the undercut materials as engineered fill to backfill undercuts, and for import of engineered fill to backfill undercuts. We recommend establishing a contingency in the construction budget for this work. Actual quantities can be verified during construction by measuring excavation volumes, counting truck loads, or a combination of methods. Since the project site has likely been subjected to past development, there is also the potential that below-grade obstructions could be encountered during site preparation and earthwork operations. We also recommend a contingency be included in the construction budget for handling such obstructions.

5. SIGNATURES

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Reviewed By:

Jeffery M. Krusinga, PE, GE
Chief Consultant

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APPENDIX A

BORING LOCATION DIAGRAM (FIGURE NO. 1)
BORING LOG TERMINOLOGY
BORING LOGS (B1 THROUGH B5)
OBSERVATION WELL LOG (OW5)

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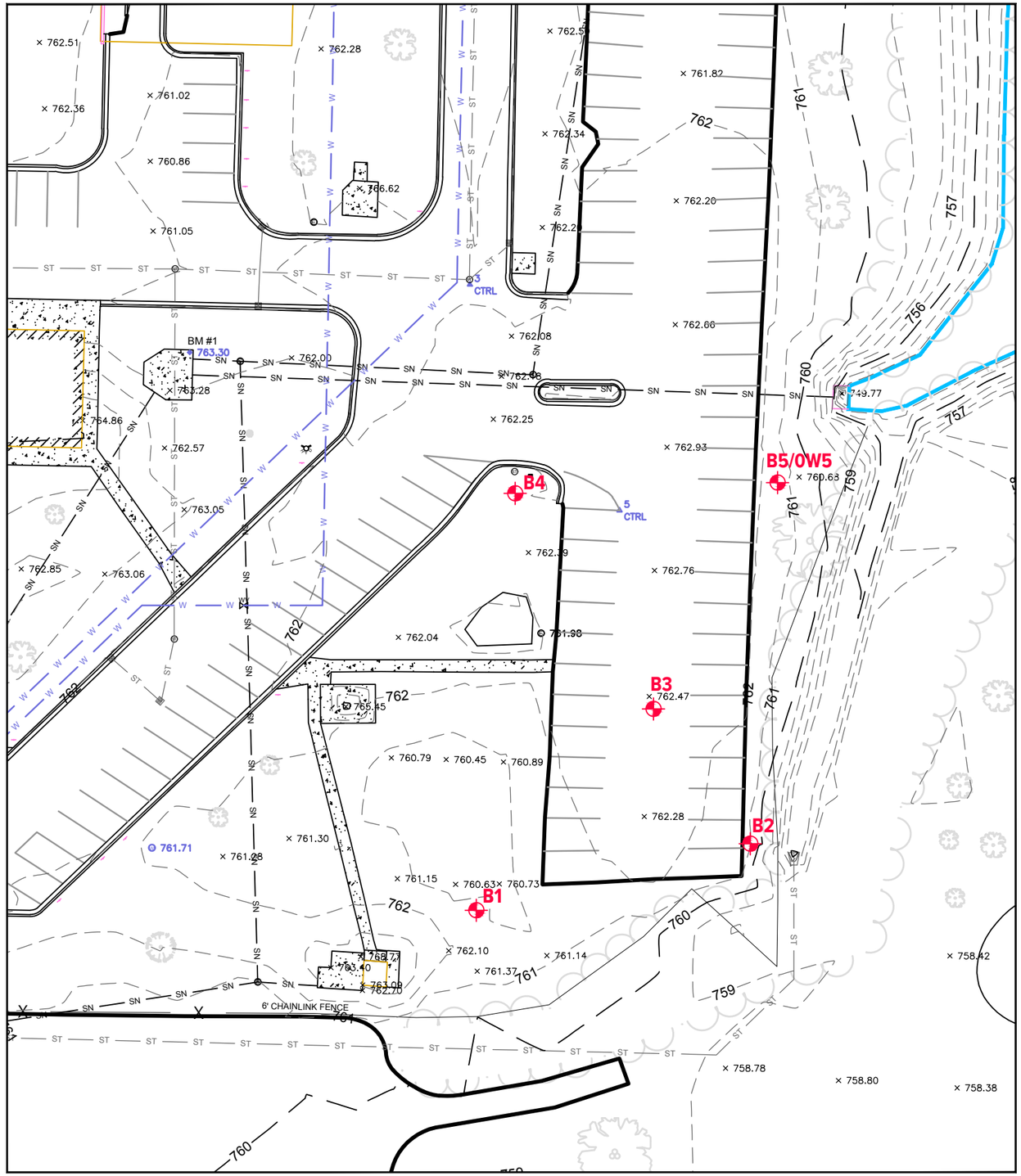

0' 40' 80'

GRAPHIC SCALE: 1" = 40'

LEGEND

APPROXIMATE BORING LOCATION	
WATER MAIN	W W W
STORM SEWER	ST ST ST
SANITARY SEWER	SN SN SN
O/H POWER	E E E
U.G. POWER	E E E

GENERAL NOTES:

1. Utilities shown are approximate locations derived from actual measurements. They should not be interpreted to be exact locations nor should it be assumed that they are the only utilities in this area.
2. Benchmark #1: Plastic tag stamped "763.76" near the NE corner of overflow chamber East of the Administration Building. ELEVATION:763.30 (NAVD88).
3. Basis of Coordinates: Michigan State Plane South, International feet.
4. Control Point Information:

NO.	NORTHING	EASTING	ELEV	
1	296855.290	12797095.924	760.27	MAG NAIL
2	296626.441	12797089.940	761.54	MAG NAIL
3	296403.981	12797084.294	761.92	MAG NAIL
4	296177.009	12796873.824	761.58	MAG NAIL
5	296331.126	12797132.506	762.99	MAG NAIL

LOCATION MAP

NOT TO SCALE

NOTE:
BASE DRAWING INFORMATION TAKEN FROM A CAD FILE 2672002 - KALAMAZOO WWTP.dwg, TITLED "TOPOGRAPHIC SURVEY FOR THE CITY OF KALAMAZOO WATER RECLAMATION FACILITY" DATED DECEMBER 4, 2020 AND PREPARED BY SUMMIT SURVEYING, INC.

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Project
KWRP BIOFILTRATION ODOR CONTROL

Project Location
CITY OF KALAMAZOO, MICHIGAN

Sheet Name
BORING LOCATION DIAGRAM

No.	Revision Date

Date 7/30/2021
CADD JAB
Designer AJR
Scale AS NOTED
Project 085267.00
Figure No. 1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA

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PLOT DATE: Jul 29, 2021 - 6:13pm - julie.blake \\Sme-inc\pz\WIP\085267.00\CAD\DWGS\BLD\rev0\085267.00-BLD.dwg

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL (more than 50% of material is larger than No. 200 sieve size.)			
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravel (Less than 5% fines)	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)	GM	Silty gravel; gravel-sand-silt mixtures
		GC	Clayey gravel; gravel-sand-clay mixtures
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sand (Less than 5% fines)	SW	Well-graded sand; sand-gravel mixtures, little or no fines
		SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)	SM	Silty sand; sand-silt-gravel mixtures
		SC	Clayey sand; sand–clay-gravel mixtures
FINE-GRAINED SOIL (50% or more of material is smaller than No. 200 sieve size)			
SILT AND CLAY Liquid limit less than 50%		ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
		CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
		OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater		MH	Inorganic silt of high plasticity, elastic silt
		CH	Inorganic clay of high plasticity, fat clay
		OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL		PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

Topsoil, Void, Sandstone, Asphalt Concrete, Glacial Till, Siltstone, Aggregate Base, Coal, Limestone, Portland Cement Concrete, Shale, Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……GW, GP, SW, SP
More than 12 percent……GM, GC, SM, SC
5 to 12 percent……Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

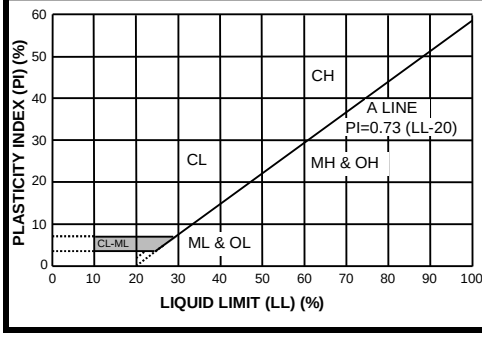
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressuremeter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

DESCRIPTION OF RELATIVE QUANTITIES

The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines:

Trace	–	particles are present but estimated to be less than 5%
Few	–	5 to 10%
Little	–	15 to 25%
Some	–	30 to 45%
Mostly	–	50 to 100%

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	N_{60} (N-Value) (Blows per foot)
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	Over 81

Cohesive Soils

Consistency	N_{60} (N-Value) (Blows per foot)	Undrained Shear Strength (kips/ft^2)
Very Soft	<2	0.25 or less
Soft	2 - 4	> 0.25 to 0.50
Medium	5 - 8	> 0.50 to 1.0
Stiff	9 - 15	> 1.0 to 2.0
Very Stiff	16 - 30	> 2.0 to 4.0
Hard	> 30	> 4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N60 values as reported on boring logs represent raw N-values corrected for hammer efficiency only.

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BORING B1

BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20
BORING METHOD: Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75
LOGGED BY: AJR **CHECKED BY:** KJG

ELEVATION: 761± FT

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
0	760	0.8 10 inches of TOPSOIL 760.2	SB1	18	3 8 6
		FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense (SP-SM)	SB2	18	10 16 13
5	755	6.5 754.5	SB3	18	12 11 6
		7.5 753.5 FILL- Fine to Medium SILTY SAND- Brown and Black- Moist to Wet- Medium Dense (SM)			
		9.5 751.5 BURIED TOPSOIL- SANDY SILTY CLAY- Occasional Root Fragments- Black (CL/ML)	SB4	18	2 4 5
10	750		SB5	18	6 8 11
15	745	Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Medium Dense (SP)	SB6	18	5 7 15
20	740	22.0 739.0	SB7	18	6 13 15
25	735	Fine to Coarse SAND- Gray- Wet- Medium Dense (SP)	SB8	18	7 10 12
30	730	END OF BORING AT 30.0 FEET.			
35					

HAMMER EFFICIENCY: 60%
DATE:
N_{60} -- ○
10 20 30 40

DRY DENSITY (pcf) -- ■
90 100 110 120

MOISTURE & ATTERBERG LIMITS (%)
PL MC LL
10 20 30 40

SHEAR STRENGTH (KSF)
1 2 3 4
▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
◈ TRIAXIAL (UU)

REMARKS

Odors noted and staining observed at Sample SB3.

A loss-on-ignition (LOI) test performed on the buried topsoil portion of Sample SB4 indicates an organic content of about 8.8 percent. The buried topsoil portion of Sample SB4 was too disturbed to perform a shear strength test.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	7.0	754.0
▼ **AT END OF BORING:**	7.3	753.7
CAVE-IN OF BOREHOLE AT:	9.0	752.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

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BORING B2

BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan

DATE STARTED: 10/13/20 **COMPLETED:** 10/13/20 **BORING METHOD:** Hollow-stem Augers

DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION (FEET)	DEPTH (FEET)	ELEVATION: 761± FT PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
760	0	FILL- Fine to Coarse SILTY SAND with Gravel- Occasional Asphalt Pieces- Dark Brown- Moist- Medium Dense (SM)	SB1	18	6 5 6
	3.0				
755	5	FILL- Fine to Medium SAND with Silt- Frequent Clayey Sand Layers- Brown- Moist- Medium Dense (SP-SM)	SB2	18	6 8 15
	6.0				
		BURIED TOPSOIL- Fine SILTY to CLAYEY SAND- Black- Moist- Loose (SM/SC)	SB3	18	5 4 4
	8.0				
750	10	Fine SILTY SAND- Frequent Sandy Organic Silt Layers and Seams- Brown- Moist to Wet- Very Loose (SM)	SB4	18	1 1 2
	13.0				
745	15	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Medium Dense (SP)	SB5	18	7 6 12
	18.0				
740	20	Fine to Medium SAND- Brown and Gray- Wet- Medium Dense (SP)	SB6	18	7 7 8
	21.5				
735	25	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Medium Dense (SP)	SB7	18	9 9 10
	30.0		SB8	18	11 12 18
730	30	END OF BORING AT 30.0 FEET.			
	35				

HAMMER EFFICIENCY: 60%
DATE:
N_{60} -- ○
10 20 30 40

DRY DENSITY (pcf) -- ■
90 100 110 120

MOISTURE & ATTERBERG LIMITS (%)
PL MC LL
10 20 30 40

▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)
SHEAR STRENGTH (KSF)
1 2 3 4

REMARKS

A loss-on-ignition (LOI) test performed on Sample SB3 indicates an organic content of about 7.3 percent. Moisture content test was performed on a sandy organic silt layer from Sample SB4.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	9.0	752.0
▼ **AT END OF BORING:**	9.0	752.0
CAVE-IN OF BOREHOLE AT:	9.7	751.3

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

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BORING B3

BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan

DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers

DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION: 762± FT

Depth (ft)	Elevation (ft)	Profile Description	Sample	Recovery (in)	SPT Blows per Six Inches
0	762				
0.5	761.5	5 1/2 inches of ASPHALT PAVEMENT			
1.8	760.2	FILL- Fine to Coarse SAND- Light Brown- Moist (SP)	SB1	18	4 14 15
			SB2	18	17 24 27
		FILL- Fine to Medium SAND with Silt- Brown to Grayish Brown at 5.5 feet- Moist- Medium Dense to Very Dense (SP-SM)	SB3	18	7 17 15
8.5	753.5		SB4	18	5 6 9
10.5	751.5	BURIED TOPSOIL- Fine SILTY to CLAYEY SAND- Black- Moist- Medium Dense (SM/SC)	SB5	18	3 3 4
			SB6	18	5 15 17
		Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Loose to Dense (SP)	SB7	18	7 11 13
30.0	732.0		SB8	18	8 14 12
		END OF BORING AT 30.0 FEET.			

HAMMER EFFICIENCY: 60%
DATE:
N_{60} --

DRY DENSITY (pcf) -- ■
90 100 110 120

MOISTURE & ATTERBERG LIMITS (%)
PL MC LL
10 20 30 40

HAND PENE.
TORVANE SHEAR
UNC. COMP.
VANE SHEAR (PK)
VANE SHEAR (REM)
TRIAXIAL (UU)
SHEAR STRENGTH (KSF)
1 2 3 4

REMARKS

A loss-on-ignition (LOI) test performed on Sample SB4 indicates an organic content of about 10.1 percent.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	10.5	751.5
▼ **AT END OF BORING:**	10.3	751.7
CAVE-IN OF BOREHOLE AT:	13.0	749.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

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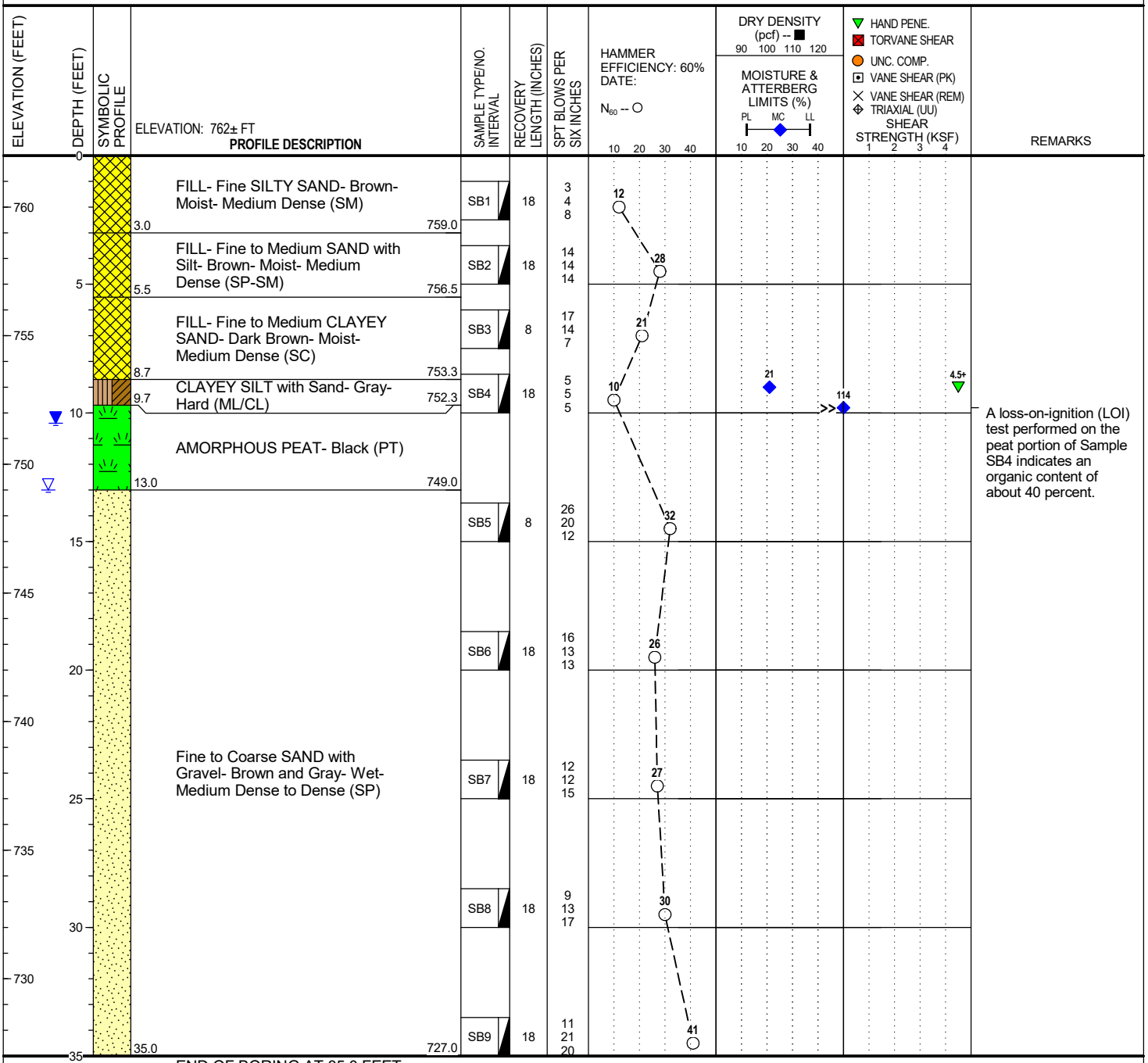
BORING B4

BORING DEPTH: 35 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan

DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers

DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG



END OF BORING AT 35.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	13.0	749.0
▼ **AT END OF BORING:**	10.4	751.6
CAVE-IN OF BOREHOLE AT:	11.0	751.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

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BORING B5

BORING DEPTH: 35 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20
BORING METHOD: Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75
LOGGED BY: AJR **CHECKED BY:** KJG

ELEVATION: 762± FT

DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
0	FILL- Fine to Medium SILTY SAND- Occasional Wood Pieces- Brown- Moist- Medium Dense (SM)	SB1	18	5 5 11
3.0 / 759.0	FILL- Fine to Medium SILTY SAND- Frequent Clayey Sand Layers- Gray- Moist- Medium Dense (SM)	SB2	18	13 14 14
5.5 / 756.5	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense to Loose (SP-SM)	SB3	18	8 10 7
9.5 / 752.5	BURIED TOPSOIL- Fine CLAYEY SAND- Dark Brown to Black- Moist- Loose (SC)	SB4	6	5 4 3
12.0 / 750.0	Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Dense (SP)	SB5	18	5 4 3
		SB6	18	7 9 11
		SB7	18	6 11 16
		SB8	18	9 13 15
		SB9	18	12 14 17
35.0 / 727.0	END OF BORING AT 35.0 FEET.			

HAMMER EFFICIENCY: 60%
DATE:
N_{60} -- ○
10 20 30 40

DRY DENSITY (pcf) -- ■
90 100 110 120

MOISTURE & ATTERBERG LIMITS (%)
PL MC LL
10 20 30 40

SHEAR STRENGTH (KSF)
1 2 3 4
▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)

REMARKS

A loss-on-ignition (LOI) test performed on the buried topsoil portion of Sample SB4 indicates an organic content of about 7.2 percent.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	12.0	750.0
▼ **AT END OF BORING:**	Note 4	

BACKFILL METHOD: Note 4

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.
4. Observation Well OW5 constructed in the borehole upon completion.

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WELL OW5

WELL DEPTH 18+/- FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan

DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers

DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION: 762± FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION
	0	
760	3.0	FILL- Fine to Medium SILTY SAND- Occasional Wood Pieces- Brown- Moist- Medium Dense (SM)
	5.5	FILL- Fine to Medium SILTY SAND- Frequent Clayey Sand Layers- Gray- Moist- Medium Dense (SM)
755	9.5	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense to Loose (SP-SM)
	12.0	BURIED TOPSOIL- Fine CLAYEY SAND- Dark Brown to Black- Moist- Loose (SC)
750		
745		Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Dense (SP)
740		
735		
730	35.0	

759.0 | 756.5 | 752.5 | 750.0 | 727.0

WELL DIAGRAM

-2.2 FT

- 2-inch diameter Riser Pipe with Expandable Pressure Cap
  Top of Riser Pipe Elevation = 764.28 feet
- Auger Cuttings
- 2-inch diameter Flush Threaded Sch. 40 PVC Well Casing, 10.3 feet long
- Bentonite Chips
- Well Sand
- 6 3/4 inch diameter Borehole
- 2-inch diameter Sch. 40 PVC with 0.010-inch Slot Size Well Screen, 10 feet long
- Bottom Plug

REMARKS

END OF BORING AT 35.0 FEET.

GROUNDWATER INFORMATION

WELL WATER LEVEL DATA

DATE	DEPTH (FT)	ELEV (FT)
8/5/2021	11.27	753.01

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Observation well OW5 constructed in the borehole of boring B5 upon completion. See the log for boring B5 for more information on sampling details and the soil profile description.
4. Depth to groundwater measured from the top of casing.

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT
GENERAL COMMENTS
LABORATORY TESTING PROCEDURES

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

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LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440º C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a ½-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool ½ inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.

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ATTACHMENT B
Reference Contract Documents

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Bid Reference #: 91359-003.0

February 2022

Reference Contract Documents

Contract No. 1 – Sewage Treatment Works – November 1952 Jones Henry & Williams Consulting Engineers

Contract No. 17 Divisions A & B – Sanitary Sewers and Appurtenances – 1963 – Jones, Henry & Williams Consulting Engineers

Contract No. 22 – Sewage Treatment Works Secondary Treatment Plant and Riverview Pumping Station – December 1964 – Jones, Henry & Williams Engineers

Contract No. 23 – Riverview Interceptor and Force Main – 1964 – Jones, Henry & Williams Engineers

Contract No. 27 – Fourth Aeration Tank and Appurtenances – 1968 – Jones & Henry Engineers

Contract No. 29 – Sludge Treatment Facilities – 1969 – Jones & Henry Engineers

Contract 37 – Interceptors and Relief Sewers – 1978 – Jones & Henry Engineers

Contract No. 38 – Wastewater Treatment Plant Additions – 1978 – Jones & Henry Engineers

Contract No. 40 – Wastewater Treatment Plant Additions – 1980 – Jones & Henry Engineers

Contract No. 41 Division A – Wastewater Treatment Plant Additions – 1981 – Jones & Henry Engineers

Contract No. 42 Division A – Water Reclamation Plant Additions – 1991 – Jones & Henry Engineers

Contract No. 42 Divisions B & D – Water Reclamation Plant Additions – 1990 – Jones & Henry Engineers

Contract No. 42 Division C – Water Reclamation Plant Additions – 1990 – Jones & Henry Engineers

Contract 45 – Water Reclamation Plant Pilot Facility – 1993 – Jones & Henry Engineers

Contract 46 – Water Reclamation Plant Secondary Clarifier & Pump Station Improvements – 1996 – Jones & Henry Engineers

Contract No. 48 – Water Reclamation Plant Capital Improvements Program Septage Receiving Facilities – 1996 – Black & Veatch

Contract 52E – Container Access Ramp & Staging Area – 2000 – Jones & Henry Engineers

Contract No. 54 – Water Reclamation Plant Capital Improvements Program Scum Collection and Handling Improvements, March 1999 – Black & Veatch

Contract 59 – PAC Feed Improvements – 2004 – Jones & Henry Engineers

Contract 61 – Sodium Hypochlorite Conversion – 2005 – Jones & Henry Engineers

Contract 63 – Water Reclamation Plant Headworks Improvements – Phase I Fine Screen Facility – January 2006 – Black & Veatch

Contract No. 64A – Tertiary Pump Station Screw Pump Replacement No. 1 – 2008 – Jones & Henry Engineers

Contract 71 – Water Reclamation Plant Demolition of Abandoned Buildings – 2012 – Jones & Henry Engineers

Contract No. 74 – Water Reclamation Facility Improvements – 2018 – Conformed Construction Drawings – Jones & Henry Engineers

Contract 75 – Tertiary Treatment Process Upgrade – 2021 – Conformed Construction Drawings – Jones & Henry Engineers

ATTACHMENT C
SPECIFICATIONS

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Bid Reference #: 91359-003.0

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IF ANY OF THE PAGES LISTED ABOVE ARE NOT INCLUDED IN THESE CONTRACT DOCUMENTS, PLEASE ADVISE.

END OF SECTION

SECTION 01043
COORDINATION AND CONTROL OF THE WORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes coordination and control of the Work.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. Haul routes to and from Site.

b. Plan and procedures for any shut downs and bypass pumping.

c. Coordination drawings shall include, but not be limited to, all process piping including, but not limited to, bill of material, laying length, embedded conduit runs, and embedded plumbing lines.

1.03 LINES AND GRADES

A. All Work under this Contract shall be built in accordance with the lines and grades shown on the Drawings or as altered or modified by authority of the Owner and Engineer.

1.04 EXISTING STRUCTURES SHOWN ON DRAWINGS

A. Where underground and surface structures are shown on the Drawings, the location, depth, and dimensions of such structures are believed to be reasonably correct but are not guaranteed.

B. Such structures are shown for the information of the Contractor, but information so given is not to be construed as a representation that such structures will in all cases be found or encountered just where shown, or that they represent all the structures which may be encountered.

1.05 COOPERATION OF CONTRACTOR

A. The Contractor shall conduct his operations so as to interfere as little as possible with those of the Owner, other contractors, utilities, or any public authority on or near the Work.

B. The Owner reserves the right to perform other Work by contract or otherwise, and to permit other public bodies, public utility companies, and others to do Work on or near the project during progress of the Work. If a conflict arises, the Owner will determine when and how the Work shall proceed.

C. Claims for delay or inconvenience due to operations of such other parties on Work specified, shown on the Drawings, as directed or which can be reasonably expected to be encountered by the nature and location of the Work will not be considered.

D. Operations entailing the use of construction equipment and lights outside the hours or 8:00 am and 5:00 pm or outside the hours allowed for construction by local ordinances or regulations are prohibited unless otherwise authorized by the Owner.

1.06 MAINTENANCE OF SANITARY SYSTEM DURING CONSTRUCTION

A. All construction which requires interruption of treatment plant flow shall be executed during periods designated by the Owner. Bypassing of untreated or partially-treated wastewater to the receiving stream is prohibited.

B. The Contractor shall be responsible for adverse environmental effects, or compliance violations at the existing treatment facilities which occur as a result of the Contractor's noncompliance with the requirements and constraints included in the Contract Documents.

C. The Contractor shall be responsible for sampling and testing, and penalties resulting from the non-performance of the Contractor's work.

1.07 PERMANENT PAVEMENT AND FINAL RESTORATION

A. Permanent pavement and final restoration shall be completed prior to the close of the last paving season prior to the Contract's final completion.

1.08 TEMPORARY PAVEMENT RESTORATION

A. The Contractor shall maintain the treatment plant access roads for operating personnel, deliveries of operating supplies, normal plant maintenance vehicles, and other equipment incidental to the operation and maintenance of the treatment facility.

1.09 TEMPORARY PARKING FACILITIES

A. Parking spaces for the Contractor's personnel shall be provided and maintained in usable condition by the Contractor at all times. Provisions shall be made so that sediment is not tracked onto paved roadways from the vehicles operated by the Contractor's personnel. The parking areas shall consist of temporary parking areas or new permanent parking areas shown on the Drawings. Temporary parking areas are to be located in the area designated by the Owner and Engineer. At the completion of the

project, temporary parking areas shall be removed and the surface restored as specified, shown on the Drawings, as directed or to its original condition.

B. The Contractor's personnel shall not utilize existing permanent parking areas unless specifically noted otherwise on the Drawings.

1. At no time shall Contractor personnel park along curbs, within the Water Reclamation Plant site, which have been painted yellow.

1.10 TEMPORARY WATER, HEATING, LIGHTING AND POWER

A. The Contractor shall provide all water, heat, lighting, and power required to construct and protect the Work until Final Completion.

B. The source for temporary power shall be from the electric utility or portable power source.

C. The source for temporary water can be from the water utility if available. The Contractor shall furnish all backflow prevention devices, flow meter and appurtenances as may be required by the water utility. Should the water utility impose a charge for furnishing, to the Contractor, the meter or appurtenances the Contractor shall pay all the fees. The Contractor shall pay all charges for the water metered.

D. The Contractor shall pay for all significant amounts of electric power utilized by the Contractor in the construction of the facility. All electric power used for such significant uses as pumping groundwater and heating shall be separately metered and paid for by the Contractor.

E. The installation for electric power shall meet the requirements of federal, state, and local authorities and regulatory agencies.

1.11 DISPOSAL OF DEBRIS

A. All debris resulting from construction operations, i.e., packaging, waste materials, damaged equipment, etc., shall be trucked from the Site by the Contractor and disposed of at spoil sites.

B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed from public or private rights-of-way.

C. All debris shall be disposed of in accordance with federal, state, and local laws and regulations.

1.12 CONTROL OF NOISE

A. The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries, and schools, precautions shall be taken to avoid noise and other nuisance, and

the Contractor shall require strict observances of all pertinent ordinances and regulations. Any blasting permitted in such locations shall be done with reduced charges.

1.13 SMOKE PREVENTION

A. Strict compliance with all ordinances regulating the production and emission of smoke will be required, and the Contractor shall accept full responsibility for all damage that may occur to property as a result of negligence in providing required control.

1.14 DEBRIS AND DUST CONTROL

A. The Contractor shall apply water, dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor as site conditions dictate or as order by the Owner and Engineer.

B. The Contractor shall utilize mechanical equipment to remove all debris from all streets, drives and walks to the satisfaction of the Owner and Engineer. Cleaning shall be performed at a minimum of daily and as directed by the Owner and Engineer.

C. The cost of the all debris and dust control methods shall be the responsibility of the Contractor.

1.15 RESERVED

1.16 RESERVED

1.17 EMERGENCY MAINTENANCE SUPERVISOR

A. The Contractor shall submit to the Engineer the names, addresses, and telephone numbers of two employees responsible for performing emergency maintenance and repairs when the Contractor is not working. These employees shall be designated in writing by the Contractor to act as his representative and shall have full authority to act on his behalf as specified in GC 6.2 of the General Conditions.

B. Contractor shall post at job Site, in a conspicuous location, the emergency numbers for the project.

C. Contractor shall be responsible for contacting the local fire, police, and emergency response personnel and organizations in advance of the Work. The Contractor shall be responsible for the coordination and compliance with emergency response plans, whether developed by the governing agency, laws, or the Contractor for the project.

D. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.18 PUBLIC SERVICE STRUCTURES

A. Public service structures shall be understood to include all poles, tracks, pipes, wires, conduits, house-service connections, vaults, manholes, and other appurtenances, whether owned or controlled by the Owner or other public bodies or by privately-owned corporations, used to supply the public with transportation, heating, electric, telephone, gas, water, sewer, or other services.

B. At least a week in advance of breaking ground, the Contractor shall notify the registered underground protection service, all public bodies, and other owners of such facilities of the proposed location of his operations, advising them that their property may be affected and that such measures as they may deem necessary should be promptly taken to protect, adjust, remove, or build them.

C. In developed residential and commercial areas, the Contractor shall assume each building and dwelling has water and sewer services and that they shall be protected and repaired as needed as part of the pipeline installation. No additional payment will be made for Work associated with supporting or repairs of such services.

D. Three conditions which may be encountered will be dealt with as follows:

1. Structures which are adjacent to but not included within the limits of an excavation required for performance of the Work shall be protected, supported, and maintained in service by the Contractor at his expense.

2. Structures within the limits of the Work which can be satisfactorily supported and maintained in service and which do not require removal and rebuilding in the judgment of the Engineer shall be thus supported by the Contractor at his expense, including cost of repair of damage incident to his operations.

    a. Supports for water and gas mains, sewers, conduits, and similar structures shall be constructed of timber or other acceptable materials; shall be supported from undisturbed foundations, and shall be sufficiently substantial to ensure against settlement when pipe trenches or other excavations are backfilled. In all cases where permits or inspection fees are required by utilities in connection with changes to or temporary support of their conduits, the Contractor shall secure such permits and pay all permit and inspection fees.

    b. The Contractor shall assume full responsibility for maintaining all public service structures in service and shall support and protect, or remove and rebuild them at his own expense. Such services shall not be interrupted without permission of the owner of the public service structure.

3. In case relocation of pipelines or other utility structures is required because of direct interference, as determined jointly by the Owner, Engineer, and Contractor, with the installation of the Work, the Contractor shall notify the Owners of the utility structure involved.

a. The Contractor will not be reimbursed for the cost of the relocation if the interference is shown on the Drawings, described in the Specifications, apparent on visual inspection, or specifically included in the Work to be performed by the Contractor.

b. The Contractor will not be paid for time lost because of such direct interference. Where it is the policy of any utility owner to perform such Work with his own forces, the Contractor shall cooperate to the fullest extent with such utility owner.

1.19 UNAUTHORIZED OR PROHIBITED WORK

A. Work done beyond the lines shown on the Drawings or ordered, Work done without required inspection, except as herein provided, or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed at the Contractor's expense. Work done without lines and grades being given shall be considered as unauthorized and subject to rejection.

B. Disposing of excess or unsuitable materials, including but not limited to excavated material, demolition debris, clearing and grubbing debris, in wetlands or flood plains.

C. Locating stockpiles in environmentally sensitive areas.

D. Pumping of sediment-laden water from trenches or excavations directly into any surface waters, stream, wetlands, or sewers. Pumped water shall be properly filtered and desilted prior to discharge.

E. Open burning without a permit.

F. Discharging injurious silica dust concentrations into the atmosphere within 200 feet of any residential or commercial, or public or private places of human occupancy.

1.20 DRAINING OF TANKS AND PIPELINES

A. Unless otherwise indicated, tanks, pipelines, and other similar structures that are to be removed from service, to complete the Work will be initially drained by the Owner.

B. Draining will be by gravity or by a permanently installed pump, if available.

C. After the tank has been drained by the Owner to the lowest level possible with existing means for drainage, the Contractor shall remove and dispose of remaining liquid and accumulated solids, as required to complete the Work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 SPECIAL PROVISIONS

4.01 CITY PROCURED EQUIPMENT

A. The Owner will procure certain pieces of equipment and project items under separate agreements for installation under this agreement.

B. Contractor shall be responsible for installing all Owner-procured materials, devices, and equipment under this project per the specifications and drawings.

C. Contractor shall be responsible for providing and installing all necessary conduit, wire, piping, valves, fittings, and appurtenances necessary to complete the installation of the total project.

D. City procured item(s) include:

1. Pre-Engineered Metal Building
    a. Includes structural members/framing, insulated metal wall panels, insulated metal roof panels, and appurtenances.
2. Biofilter Items
    a. Biofilter Control Panel (x1)
    b. Media Support Grating (x3)
    c. Upper Surface Spray Irrigation System (x3)
    d. Lower In-Bed Irrigation System (x3)
    e. Biofilter Media (x3 lots)
    f. Biofilter internal baffles (x3 lots)
    g. 36-inch x 36-inch Side Access Hatches (x3)
    h. Humidification Sprayers and Penetrations (x3)
    i. Humidification Chamber Air Deflectors (x3)
    j. Aluminum Covers (x3)
3. Carbon Scrubbers with Integral Mist/Grease Eliminators (x3)
4. Water Irrigation Control Panel (x3)
5. Nutrient Metering Pump (x3)
6. Nutrient Tank (x1)
7. Nutrients (lot)
8. Humidification Recirculating Sump Pump (x2)
9. Pressure/Flow Instrumentation (lot)
10. Mist/Grease Eliminator (x1)

11. Centrifugal Fan/Blowers w/ 50 HP motors (x3)
    a. Ductwork transition pieces into/out of provided fans/blowers
12. Centrifugal Fan/Blower VFD Panels, includes VFDs (x3)
13.

4.02 MAINTAINING FLOW IN EXISTING SEWERS

A. Flow in existing storm, sanitary and private sewers shall be maintained at all times during construction of this project. The Contractor shall furnish and install all necessary temporary facilities required to maintain the flow in existing sewers including bulkheads, plugs, stop planks, flumes, coffer dams, pumping equipment, valves, etc.

4.03 POTENTIALLY HAZARDOUS ENVIRONMENT

A. The environment in portions of the Site is rated as Class I Division 1 or 2 or some areas of the Site are designated as permitted Confined Spaces. As a minimum, whenever the Contractor is performing Work in these areas, the Contractor shall provide Factory Mutual- and UL-approved continuous monitoring of the atmosphere for the presence of hydrogen sulfides, of low oxygen concentration, and of explosive gases (both lighter and heavier than air). The Contractor shall evacuate all personnel from the areas whenever the detection system registers hydrogen sulfide levels of greater than 20 ppm, oxygen levels less than 19.5% or combustible gas levels of greater than 10% of the LEL. In addition, whenever the Contractor is using tools producing open flames or sparks, such as cutting torches, saws, and grinders, the Contractor shall provide for the forced air exhaust ducted from the immediate area of the Work.

4.04 REQUIRED SAFETY DOCUMENTATION TO BE SUBMITTED

A. On all projects that require the Contractor's or subcontractor's personnel to occupy permitted confined spaces and/or hazardous atmospheres on the Site, the Contractor shall submit to the Owner, a written proposed safety program. The safety program shall comply with all Federal, State, and local requirements. If the Owner has a safety plan that is more stringent than the Federal and State requirements, it will be made available to the Contractor for review. The submittal of the proposed safety program to the Owner shall be made well in advance of the start of construction at the Site. The submittal shall include a written Safety Management Plan including Confined Space Entry procedures. The Contractor shall be responsible to maintain documentation that anyone employed by the Contractor, subcontractors, or suppliers of any tier to the Contractor occupying such hazardous locations has received the appropriate confined space entry training and other applicable training. The Contractor is also responsible to maintain completed confined space entry permits.

4.05 MAINTAINING CRITICAL OPERATIONS

A. .

B. The Contractor shall closely coordinate any needed equipment shutdowns with the Owner.

C. The power and control work for existing equipment shall be arranged and sequenced to minimize the downtime of all equipment. In general, only one item of equipment can be out of service at any one time and the unavailability of equipment shall be kept to a minimum duration.

D. Any Work that requires any plant equipment to be unavailable for use by the plant staff must be scheduled one week in advance of the planned outage.

END OF SECTION

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SECTION 01090
REFERENCE STANDARDS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes reference standards.

1.02 DESIGNATION OF ASSOCIATIONS, INSTITUTIONS, SOCIETIES AND STANDARDS

A. Whenever in these Specifications reference is made to Associations, Institutions, Societies, or Standards, they will be designated as follows:

AA	-	Aluminum Association
AAMA	-	Architectural Aluminum Manufacturers Association
AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ADAAG	-	Americans with Disabilities Act Accessibility Guidelines
AFBMA	-	Anti-Friction Bearing Manufacturers Association
AFI	-	Air Filter Institute
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIHA	-	American Industrial Hygiene Association
AISC	-	American Institute of Steel Construction
AISI	-	American Iron & Steel Institute
AITC	-	American Institute of Timber Construction
AMCA	-	Air Moving and Conditioning Association
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
ARI	-	Air Conditioning and Refrigeration Institute
ASA	-	American Standards Association
ASHRAE	-	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing Materials
AWPB	-	American Wood Preservers Bureau
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BLS	-	Bureau of Labor Standards
CISPI	-	Cast Iron Soil Pipe Institute
FM	-	Factory Mutual
FS	-	Federal Specifications

IBR	-	Institute of Boiler and Radiator Manufacturers
IEEE	-	Institute of Electrical and Electronic Engineers
INETA	-	International Electrical Testing Association
ISA	-	Instrument Society of America
JIC	-	Joint Industrial Council
MDOT	-	Michigan Department of Transportation
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NICET	-	National Institute for Certification in Engineering Technologies
NSF	-	National Sanitation Foundation
NRTL	-	Nationally Recognized Testing Laboratory
OSHA	-	Occupational Safety and Health Act
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	-	Steel Structures Painting Council
MBC	-	Michigan Building Code
IBC	-	International Building Code
UBC	-	Uniform Building Code
UL	-	Underwriters Laboratories, Inc.
USBM	-	United States Bureau of Mines

B. Wherever specific standard numbers are indicated, i.e., ASTM C150, it shall be understood to mean the latest revision thereof.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes requirements for submittals.

B. Contractor shall adhere to the submittal schedule as submitted under the provisions of the General Conditions. Contractor shall modify the schedule as required to allow sufficient time for submittal review based on current construction schedule.

C. Owner, Contractor and Engineer shall utilize the electronic project management system EPMS as specified in Section 01320 for the central repository of project related documents including but not limited to submittals, information for the record and Operation and maintenance manuals.

1.02 COORDINATION OF SUBMITTALS

A. The Contractor shall be responsible for the coordination of submittals and field verifications as required for the various parts of the Work.

B. All submittals to the Engineer, unless otherwise specified, shall be made only by the Contractor. Direct submittals from subcontractors or suppliers will not be accepted.

C. All submittals shall reference the Specification item that it covers, the Contractor's name, the Contract title and location, and the date of submission. Submittal shall also indicate whether the information is for the Engineer's review and approval, for record purposes, or for the fulfillment of the operation and maintenance requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Two categories of information are normally required:

1. Shop Drawings for review.
2. Information for Record:
    a. Operation and maintenance manuals.

2.02 SHOP DRAWINGS FOR REVIEW

A. Shop Drawings:

1. The Contractor shall submit Shop Drawings in accordance with the individual Specification Sections, shown on the Drawings or as directed.

2. The Contractor shall indicate all variances from the requirements of the Contract Documents in accordance with the General Conditions.

3. The Contractor shall clearly indicate quantities and the exact intended use of the equipment or material contained in the submittal.

4. All Submittals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or where applicable the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual material or equipment furnished. All options furnished shall be indicated.

5. Color charts or samples shall be included for all submittals where a color selection by the Owner is required. Original Color Charts (not Color Copies) and samples shall be delivered to the Site, Engineer's RPR or Owner as required. The Engineer shall be copied on the transmittal letter for record purposes.

B. Samples shall be provided as required in the individual Sections. Samples shall be of the precise material proposed to be furnished. The number of samples and sample size shall be the industry standard unless otherwise stated in the individual Sections.

2.03 INFORMATION FOR RECORD

A. Material certificates shall be submitted for materials as indicated in the individual Sections. The certificate shall state that the products have been sampled and tested in accordance with the proper industrial and governmental standards and meet the requirements of the Specifications. Certificates shall be signed by an authorized agent of the manufacturer.

B. Licenses and Permits - The Contractor shall submit copies of all licenses and permits required by Local, State, and Federal laws.

C. Installation and calibration certificates shall be submitted for equipment as indicated in the individual Sections. These certificates shall indicate manufacturer's satisfaction with the installation, the accuracy of calibration and alignment, and the operation of the equipment. Such certificates must be signed by an authorized agent of the manufacturer.

D. Progress Schedules shall be submitted in accordance with Section 01310.

E. Schedule of Shop Drawings and Sample Submittals shall be submitted for review/approval prior to the Engineer reviewing any other submittal.

F. Schedule of Values shall be submitted for review and approval.

G. Copy of programming for all PLC's and computers on the project.

1. Programming shall be a fully unlocked copy of the programming capable of being modified by and uploaded by the Owner at their discretion.

2.04 OPERATION AND MAINTENANCE INFORMATION

A. Operation and maintenance manuals shall be submitted as information for the record.

B. Operation and maintenance manuals shall be submitted as electronic documents prior to the printing of the record copy.

1. Contractor shall provide one electronic copy of the manuals for preliminary review.

2. The final accepted manuals shall be provided as one electronic copy of the manual and one printed copy as specified below.

C. Electronic manuals shall be in Portable Document Format (PDF) as generated by Adobe Professional Version 7.0 or newer. The PDF file shall be fully indexed using the table of contents, searchable with thumbnails generated. PDF documents shall have bookmark created in the navigation frame for each major entry (Section, Chapter, Tab) in the table of contents. PDF images shall be at a readable resolution typically 300 dpi or higher. Optical Character Recognition (OCR) capture shall be performed on these images text can be searched, selected and copied from the PDF file.

1. The opening view of each PDF document shall be the bookmarks to the left and cover page or table of contents.

2. The PDF file name shall include the Name of Owner, Project title, Contract Number, and Specification Section. Commonly used abbreviations acceptable to the Owner may be used to minimize length of file name.

3. The Contractors Name shall be the electronic “Author” of the PDF document.

D. This information will be reviewed only if properly identified with Specification Section numbers and only after revised, where necessary, to conform to the Engineer’s notes on previous submittals that have been marked “Approved As Noted.” Manuals shall be tailored to suit the specific equipment provided.

E. Submittals shall include but not limited to the following:

1. Descriptive literature, bulletins, or other data covering equipment or system.

2. Complete list of equipment and appurtenances included with system, complete with manufacturer serial number and model number.

3. Utility requirements.

4. General arrangement drawing.

5. Sectional assembly.

6. Dimension print.

7. Materials of construction.

8. Certified performance curve.

9. Parts list with assembly drawings.

10. Recommended spare parts list with part and catalog number.
11. Lubrication recommendations and instructions.
12. Schematic wiring diagrams.
13. Schematic piping diagrams.
14. Description of associated instrumentation.
15. Drive dimensions and data.
16. Operating instructions.
17. Maintenance instructions including trouble-shooting guidelines, lubrication, and preventive maintenance instructions with task schedule.
18. Special tools and equipment required for operation and maintenance.
19. Description of equipment controls.
20. Pump seal data.
21. Assembly, installation, alignment, adjustment, and checking instructions.
22. Confirmation of all corrections noted on Shop Drawings marked “Make Corrections Noted.”
23. Manufacturer’s name, address, and telephone number along with manufacturers job number and Purchase Order number.
24. Manufacturer’s local sales representative, address, telephone number.
25. All installation instructions that were provided to Contractor for use to install equipment.

F. All manuals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual equipment furnished. All options furnished shall be indicated.

G. Manuals shall be printed on 8-1/2 by 11-inch size with standard three-hole punching. Large manuals shall be submitted in three-ring binders. Small manuals shall be submitted in folders with metal fasteners. Index tabs shall be furnished for all manuals containing data for three or more items of equipment. All manuals shall have a title label on the cover stating the specification item number and item name. A table of contents shall be included in all manuals.

H. Drawings shall be reduced to 8-1/2 by 11 inch or 11 by 17 inch. Where reduction is not possible, larger drawings shall be folded separately and placed in envelopes which are bound into the manual.

I. Equipment installations shall not be considered substantially complete until all associated operation and maintenance manual submittals and startup reports are accepted by the Engineer.

J. Field modifications to equipment during installation shall be included in the manual so that the manual reflects as-built conditions. Revisions to the manual may be submitted for incorporation into the manual where appropriate. However, the Engineer reserves the right to return all six manuals for revision to reflect as-built conditions.

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Contractor shall submit a schedule of submittals for review and approval.

B. The schedule of submittals shall identify, by specification section, the following:

1. Indicate submittals required for each specification section. There may be more than one equipment or product specified in each Specification Section, thus there may be a need for multiple submittals from each Specification Section.
2. If submittals will be broken down by structure or area they shall be listed separately (i.e. structural reinforcement drawings by building, conduit layout by building).
3. Indicate whether a sample or color selection is required
4. Indicate manufacturer O&M Manuals and installation certificate is required.
5. Indicate whether a startup and start up report is required.
6. Indicate whether a manufacturer warrant is required.
7. Indicate whether training is required.
8. Indicate whether spare parts required.
9. Include the name of the subcontractor or vendor.

3.02 IDENTIFICATION OF SUBMITTALS

A. All submittals shall have a Submittal Identification & Approval cover sheet attached. A sample of the submittal cover sheet is attached for reference. The form will be provided by Engineer and coordinated with Contractor.

B. All submittals shall be given a consecutive number when they are entered into the Electronic Project Management System (EPMS), See Section 01320.

C. Resubmittals shall be entered into EPMS as resubmittals.

D. Submittals to satisfy the operation and maintenance information requirements shall be entered into the EPMS as a submittal. The description shall have the prefix “OM”.

3.03 PRINTING AND DISTRIBUTION

A. Contractor shall provide printed copies of approved submittals and deliver them to the Owner and Engineers RPR at the Site.

B. Contractor shall provide one printed copy of the approved operation and maintenance manual and the electronic copy on portable electronic media device to the Owner.

C. Contractor shall provide printed copies of submittals, project information or documents required to satisfy the building permit and inspections as may be required by the governing agency.

1. The Engineer will provide the stamped/sealed Contract Drawings for the initial filing of the building permit applications.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

Submittal Identification & Approval

Date:

Spec Section

Submittal No.

Drawing Sheet No.

Description:

Manufacturer(s)

Contractor Comments/Deviations/Measu nts

Contractor

Contractor Na

- ☐ Approved
- ☐ Forwarded
- ☐ Checked

By: _____ Date: _____

Engineer

SHOP DRAWING REVIEW
SUBJECT TO CONTRACT REQUIREMENTS

Jones & Henry Engineers, Ltd.

- ☐ Approved
- ☐ Approved—Make Corrections Noted
- ☐ Amend & Resubmit
- ☐ Rejected—See Remarks
- ☐ Distribute for Information

REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS

Approval in no way relieves the Contractor of any responsibility for capacities, performance, functions, compliance with Federal, State, and Local Codes; accuracy of dimensions and details; or continuity and completeness of the Project nor does approval constitute or imply any increase in Contract Price.

By: _____

Review Comments

Sample

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SECTION 01310
CONSTRUCTION SCHEDULES AND DOCUMENTATION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the requirements for construction schedules and construction sequences.

B. This Section includes the requirements for the tracking and documentation of the progress and activities driving the completion of the Work as specified, shown on the Drawings and as directed.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. Preliminary Construction Schedule.

b. Contractor's Construction Schedule and monthly updates.

c. Submittals Schedule.

d. Weekly construction schedule

B. Contractor shall submit three copies of the 24-inch by 36-inch construction schedule, unless approved otherwise by the Engineer.

1.03 QUALITY ASSURANCE

A. Scheduling conference shall be held prior to the commencement of the construction to discuss the following including, but not limited to:

1. Construction sequencing.

2. Contractor's coordination of subcontractors.

3. Coordination with the Owner's operations.

4. Coordination with other Contractor's or other Work.

5. Project milestones.

6. Owner's partial utilization.

PART 2 PRODUCTS

2.01 PRELIMINARY CONSTRUCTION SCHEDULE

A. Preliminary construction schedule shall be completed in accordance with the General Conditions and prior to the scheduling conference.

B. The preliminary schedule shall outline the Contractor's sequencing of tasks, activities, milestones, and all critical path items within the contract time.

2.02 CONSTRUCTION SCHEDULE

A. The Contractor's submission of the construction schedule will not change the contract completion date, whether reviewed by the Owner and Engineer or not. The Contractor shall incorporate all approved change orders that have resulted in a contract time extension.

B. The Contractor shall require all subcontractors engaged in the Work to submit to the Contractor construction schedules, as specified herein, for incorporation into the Contractor's construction schedule.

C. The construction schedule shall include, but not limited to, the following dates:

1. Notice to Proceed.
2. Substantial Completion and Final Completion.
3. Commencement of on-site operations.
4. Milestones as specified, shown on the Drawings, and as directed.
5. Ordering, submittals, fabrication, delivery, startup, and training time of major equipment items.
6. Submittal schedule per the General Conditions.
7. Equipment startup and training.

D. The Contractor shall incorporate into the construction schedule all constraints and work restrictions specified or otherwise required by the Contractor's operations, including, but not limited to, the following:

1. Construction sequencing.
2. Contractor's coordination of subcontractors.
3. Coordination with the Owner's operations.
4. Coordination with other Contractor's or other work.
5. Project milestones.
6. Owner's partial utilization.

2.03 UPDATING CONSTRUCTION SCHEDULE

A. The Contractor shall keep the construction schedule current to the progress of the Work continually through closeout of the project. The construction schedule shall be submitted monthly for the Engineer's review.

2.04 WEEKLY CONSTRUCTION SCHEDULE

A. The Contractor shall submit a schedule of his work for each week. This schedule shall identify the foreman of each work crew and the location and type of work the crew will be doing each day. It shall be sent via email no later than 4:00 p.m. of the next to last regular workday of the preceding week to the Resident Project Representative, Engineer, and Owner.

PART 3 EXECUTION

3.01 COORDINATION

A. All phases of the Work requiring interference with normal operations of the existing facilities shall be scheduled in accordance with agreements among the Contractor, Owner, and Engineer. The Contractor shall notify the Owner at least one week before such Work is to begin.

PART 4 SPECIAL PROVISIONS

4.01 SCHEDULED NON-WORK DAYS

A. The Contractor shall restrict Work to Monday through Friday and consider the following list of holidays as mandatory non-work days, all of which shall be incorporated into the construction schedule:

1. New Year's Day.
2. President's Day.
3. Good Friday.
4. Memorial Day.
5. Juneteenth.
6. Fourth of July.
7. Labor Day.
8. Thanksgiving Day.
9. Day after Thanksgiving Day.
10. Christmas Eve Day.
11. Christmas Day.

END OF SECTION

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SECTION 01320
ELECTRONIC PROJECT MANAGEMENT SYSTEM (EPMS)

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for the Electronic Project Management System (EPMS) which will be required on this project.

B. The Contractor shall be responsible for including the cost to the EPMS; the pricing shall be the pricing factor of 0.000707 times the Contractor's Bid. The Contractor shall be responsible for paying the cost as a onetime payment to Eastern Engineering within 30 days of the Notice to Proceed and will be considered part of the project mobilization on the schedule of values.

C. Engineer will implement an internet/web site based Electronic Project Management System (EPMS) for the administration of the Contract on this project. Owner, Contractors and Engineer shall be responsible to interface with EPMS and collaborating via the EPMS on this project. The EPMS is intended to supplement the Contract Documents and the provisions of the Contract Documents shall not be superseded by the EPMS.

1. The EPMS is intended to provide a mode of communication which is electronic and to reduce the reliance upon printed documents. Printed documents transmitted will not be reviewed, and electronic documents emailed outside of the EPMS will not be reviewed. The Owner, Contractor and Engineer will collaborate on unique situations or circumstances in order to preserve the project electronic records.

D. The Owner, Contractor and Engineer shall be required to provide project related information/documents via EPMS. In general, the EPMS will receive information via uploaded documents as PDF documents, in their native format (when permitted or required), or other electronic formats designated or required for functionality. The EPMS shall be a central repository for information to all project team members. The EPMS will provide viewing, printing, up/downloading of various information/documents.

E. In general, the following is a partial list of information/documents which shall be tracked through the EPMS:

1. Drawings, Specifications and Addendums (included revisions as necessary).
2. Insurance.
3. General Project Communication, Emails, Letters, Correspondence and Collaboration or any other document any participant wishes to make part of the project records.
4. Request for Information (RFI).

5. Submittals (Shop Drawings, Operation and maintenance manuals, color selections etc.)
6. Work Change Directives, Change Request and Change Orders.
7. Schedule of Values, Pay Requests and Certified Payroll Reports.
8. Reports and Photos (daily, monthly, etc.).
9. Schedules (project, weekly and monthly).
10. Meeting Agendas and Minutes.
11. Permits and Special Inspections Reports.
12. Laboratory Services (testing and reporting).
13. Closeout procedures (deficiency list, warranty, substantial completion).
14. Record Drawings.

F. In an effort to protect proprietary information and prohibit unauthorized use or modifications, levels of access security will be assigned in order to provide safe and secure access to information with respects to involvement and responsibility on the project. The Owner, Contractor and Engineer shall establish these levels of access and rights which are appropriate for this project.

G. Owner, Contractor and Engineer shall utilize the mark-up tool integral within the EPMS or have a PDF review software that includes the ability to mark up and apply electronic stamps (such as Adobe Acrobat, or Bluebeam PDF Revu).

H. A high-speed internet connection is required.

I. The EPMS will provide notifications regarding new or updated documents through an existing Email account outside of the EPMS.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 CONTRACT REQUIREMENTS

A. All provisions of the Contract Documents are in full effect and enforcement. The submittal procedures specified in the Contract Documents are applicable with the understanding that they will be electronic documents and submitted via the EPMS.

3.02 PRINTING, REPRODUCTION AND DISTRIBUTION

A. The Engineer will not be responsible for printing reproduction or preparation of any hard copy documents, or the cost of doing so.

B. Contractor shall produce printed copies of all submittals as required in Section 01300 and in the Contract Documents.

3.03 TRAINING

A. One training session by the Engineer and Eastern Engineering, Inc. will be provided to the team members at the beginning of the EPMS implementation. Training will be coordinated with the Preconstruction meeting and held at the same location. There are many tutorials, help features and technical support options located on the Eastern Engineering web site.

B. Engineer will provide project related support as needed within their ability to provide it. Technical support will be available to all project team members from Eastern Engineering, Inc.

3.04 OPERATION

A. Contractor and all Subcontractors shall maintain a Windows-based computer system including high speed internet access and ability to create/mark-up documents using Adobe Acrobat (pdf) and to scan documents.

B. Engineer will facilitate the implementation and overall operation of the EPMS with Eastern Engineering. Eastern Engineering will provide and maintain the EPMS server and will back up the information.

3.05 ARCHIVE PROJECT CLOSE OUT

A. All files on the EPMS web site will be archived at the end of the project. These archives will be made available to the Owner, Contractors and Engineer for download over the internet, at the end of the warranty period.

3.06 ELECTRONIC SUBMITTAL FILE NAMING CONVENTION

A. The Contractor shall utilize the following file name convention for PDF files submitted through eComm:

1. Spec Section - Number of Submittal from Section - Number of Times Submitted.

   a. Example: 02552-01-03.

2. The example represents the first submittal from Specification Section 02552 and the third time this Submittal has been submitted.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 01350
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes general requirements for all materials, equipment and systems furnished or installed under this project.

B. Additional specific requirements included under a particular Section shall take precedence.

C. This Section includes, but is not limited to, the following procedural and administrative requirements:

1. Product Delivery Storage and Handling.
2. Warranties.
3. Quality Assurance and Control.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and related specification sections.

B. The specification sections and Drawings contain the specific submittal requirements.

1.03 QUALITY ASSURANCE

A. Where Contractor is required to provide design services or certification of the design, the specified product, equipment or system shall comply with the specified criteria.

1. Contractor shall submit a written request for clarification when specified criteria is incomplete or insufficient.

B. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the Drawings.

1.04 PROJECT HANDLING

A. Schedule delivery to minimize the time goods are kept in storage.

B. Deliver goods to Site in manufacturer's original packaging.

C. Inspect the goods to determine if there is visible damage to the packaging.

1. The packaging shall be removed in a manner that will allow resealing for storage.

2. If packaging cannot be removed and reused, the goods shall be repackaged per the manufacturer's recommendations.

D. Goods that are susceptible to damage by the environmental or project conditions, including but not limited to, switchgear, motor control centers, panelboards, instrument control panels, fixtures shall be stored in a controlled environment per the manufacturer's recommendations. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner.

E. Where construction is in roads or streets, that portion of the right-of-way not required for public travel may be used for temporary storage purposes unless otherwise prohibited. Materials shall not be stored in areas where such storage creates a hazard. Any other additional space required for construction or storage of materials and equipment shall be obtained by the Contractor at his expense.

F. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

1.05 GUARANTEE

A. Manufacturer's warranty, extending beyond one-year after substantial completion for the specified product, equipment or system shall be provided to the Owner and endorsed by the manufacturer.

B. Requirements for warranties extending beyond one-year after substantial completion are described in individual Sections of these specifications.

C. Manufacturer's limitations and disclaimers shall not relieve the Contractor from warranty obligations under the Contract Documents.

PART 2 PRODUCTS

2.01 SHOP PAINTING

A. Non-galvanized ferrous surface shall be painted.

B. Shop painting of ferrous surfaces shall be as follows:

1. Surfaces shall be thoroughly cleaned of dirt, grease, oil, rust, scale, or other foreign substances. All metal surfaces shall, as a minimum, be abrasive blasted in accordance with SSPC-SP6, Commercial Blast Cleaning. More stringent surface preparation shall be provided where required by Section 09900.

2. Surfaces shall receive a shop coat of a primer compatible with the finish coating to be used by the Contractor and specified in Section 09900.

2.02 GALVANIZING

A. Where galvanized metal is indicated, unless otherwise specified, galvanizing shall conform to ASTM A123 (Hot Dip Galvanized). Threaded parts and hardware shall be galvanized in conformance with ASTM A153.

2.03 REGULATORY REQUIREMENTS

A. Materials, equipment, coatings, and chemicals in contact with potable water or water being treated for potable water use shall comply with the applicable NSF Standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Products shall be installed in accordance with the manufacturer's instructions and Contract Documents.

B. Required appurtenances including but not limited to, anchors, grout, and leveling shims, shall be provided.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 01410
LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall retain an independent laboratory.

B. Testing, inspection(s) and quality control are required to certify compliance with the Contract Documents.

1. The laboratory services do not relieve the Contractor from the responsibility of compliance with the Contract Documents

2. Any test required by the Owner shall not relieve the Contractor from the responsibility of compliance with the Contract Documents.

3. Any test required by the Owner shall not relieve the Contractor from the responsibility of supplying certificates from manufacturers or suppliers to demonstrate compliance with the Specifications.

C. Specific testing, inspection(s) and quality control requirements are specified in the individual Sections of the specifications.

D. Specific testing, inspection(s) and quality control requirements of any Federal, State or Local authorities are specified in the related sections of Work.

E. Testing of materials or equipment for compliance with various national or technical society standards and ordinarily performed by manufacturers, and shop and field tests of equipment are not included under this Section but shall be performed by the Contractor or his supplier as specified elsewhere.

F. Contractor may conduct material or field test(s), inspection(s) and quality control as they deem necessary.

1. Should the Contractor, at any time, desire the Owner to consider the results of such testing, inspection(s), and quality control, such results shall be certified by an independent testing laboratory acceptable to the Owner. Any testing of this nature shall be conducted at the Contractor’s expense.

1.02 SUBMITTALS

A. Submittals of all required field and laboratory test results shall be made by the independent laboratory as soon as they are available to the Owner and Engineer directly.

1. Statement of Compliance per 1.03

1.03 QUALITY ASSURANCE

A. The laboratory shall be a recognized and independent commercial laboratory with experience in conducting the required tests.

B. Laboratory shall certify compliance with ASTM E548, ASTM E329, and ASTM C1093 when masonry construction is part of the project scope. In lieu of ASTM certification, the laboratory may submit written documentation demonstrating experience and training relevant to the inspections to be performed. The documentation shall demonstrate experience with projects of similar complexity and quantity of inspections as the project herein.

C. Testing, inspection(s) and quality control shall be certified by a professional engineer specialized in the related field and in the state where the Site is located.

PART 2 PRODUCTS

2.01 TESTS

A. Aggregates, Bedding Material, and Special Backfill - For each type of material, the laboratory shall perform an ASTM C136 sieve and screen analysis to determine compliance with the contract documents.

1. Retests shall be performed until the Specifications are met.

2. Retest shall be performed each time the source of material is changed.

B. Selected Backfill - At the discretion of the Engineer, but in no case, more than one test for each 1,000 cubic yards or portion thereof, the laboratory shall perform an ASTM C136 sieve and screen analysis to determine whether the material is suitable for backfilling purposes.

C. Mix Designs:

1. For each type of controlled density fill, concrete, and asphalt, the laboratory shall review, perform test(s).

2. Review, perform test(s) and approve change in source of materials.

3. The asphalt design shall be made in accordance with ASTM D1559, the Marshall Method of Mix Design and as specified.

4. Approved mix designs shall include sieve analyses and suppliers' certificates for materials incorporated in the mix.

D. Compaction Tests:

1. Owner shall cover the cost for these tests directly. Contractor shall coordinate the testing with the Owner's contracted laboratory.

a. For each type of backfill material, the laboratory shall determine the moisture-density curve according to ASTM D698.

b. Using ASTM D2922 test methods, the laboratory shall determine the density of placed backfill.

c. Retests shall be performed if the compaction requirements stated in the individual Sections are not met.

d. The Engineer may at his discretion require the sand cone (ASTM D1556) or the balloon (ASTM D2167) tests for density and compaction to verify questionable results of the ASTM D2922 tests.

E. The independent testing laboratory shall test and report the soil bearing capacity under all foundations and slabs on grade. The testing shall be conducted at regular intervals in all directions. The independent testing laboratory shall immediately notify both the Contractor and Engineer of any such test not meeting the presumed soil bearing capacity contained in the Structural Design Data on the Drawings.

1. Owner shall cover the cost for these tests directly. Contractor shall coordinate the testing with the Owner's contracted laboratory.

F. Asphalt and Concrete Quality Control Testing - Perform tests as indicated in Sections 02600 and 03300.

1. Owner shall cover the cost for these tests directly. Contractor shall coordinate the testing with the Owner's contracted laboratory.

G. Miscellaneous Tests - Perform all other tests requested in the individual Sections of the Specifications.

1. Testing required by the specifications but not falling under the responsibility of the Owner per the IFB shall be the responsibility of the Contractor.

2.02 PLANT INSPECTIONS

A. Inspect and certify asphalt and concrete plants as indicated in Sections 02600 and 03300, respectively.

2.03 EQUIPMENT

A. Provide all necessary equipment to extract and store samples and perform the required tests.

PART 3 EXECUTION

3.01 COORDINATION

A. The Contractor shall provide the source of all materials requiring testing and shall arrange access for the Owner's independent laboratory to obtain representative samples and perform required tests at the material source. The information shall be supplied in advance to allow time for testing and reporting. Concrete information shall be supplied at least 45 days prior to the first concrete placement.

B. Contractor shall coordinate activities to accommodate the required quality assurance/control.

1. Contractor shall not compromise the requirement for quality assurance /control in order to maintain the schedule.

C. The laboratory shall conduct tests on materials and in locations as directed by the Resident Project Representative.

D. All tests shall be performed in accordance with the proper test methods mentioned above and in the individual Sections. Results shall be compared to the required values included in the individual Sections.

3.02 PREPARATION

A. Contractor shall prepare all Work to be tested in accordance with the testing procedures as directed and required by independent laboratory, regulatory agency, or Owner and Owner's representative.

3.03 PROTECTION

A. Contractor shall at the completion of testing, repair damage to construction in accordance with these specifications.

B. Contractor shall be responsible for the protection regardless of the responsibility for quality assurance/control.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 01500
MAINTAINING TRAFFIC

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all labor, materials, equipment and services necessary for maintaining and protecting vehicular and pedestrian traffic.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. The Contractor shall submit the name, address, and telephone number of a local individual who will be responsible for maintaining traffic facilities when the Contractor is not working.

b. Traffic control or maintenance plans with govern authority(s) approval.

c. Detour routes with governing authority(s) approval.

d. Delivery and haul routes for contractor's activities outside the zone of influence.

1.03 QUALITY ASSURANCE

A. The installation, maintenance, and operation of all traffic controls and traffic control devices shall conform to the requirements of the State Department of Transportation Manual of Uniform Traffic Control Devices for Streets and Highways, hereinafter called the MUTCD.

B. If, in the opinion of the authority having jurisdiction over traffic in the affected thoroughfares, proper maintenance of traffic facilities and proper provisions for traffic control are not being provided by the Contractor, they may take the necessary steps to place them in proper condition, and the cost of such services will be deducted from any money which may be due or become due the Contractor.

C. A traffic control conference, attended by Owner, Engineer, Contractor and governing authority, shall be held no later than 14 days prior to any traffic maintenance, placement of traffic control devices, lane closures, detouring of traffic or other activity that impedes the normal traffic flow.

PART 2 PRODUCTS

2.01 TRAFFIC CONTROL DEVICES

A. Traffic control devices shall be provided with suitable supports of sufficient strength and stability.

B. Faces of orange construction signs, barricades, vertical panels and drum bands shall be suitably reflectorized with sheeting.

C. Traffic cones shall be a highly visible orange color.

D. Pavement markings for traffic maintenance shall conform to the requirements of MDOT, the local authority and the MUTCD.

2.02 TEMPORARY TRAFFIC SIGNALS

A. The Contractor shall furnish, erect, maintain, and subsequently remove signal and signal controller equipment of a proper type and capacity to provide the required operation, and shall meet the general requirements of MDOT and the MUTCD.

1. Any malfunctions or failures shall be corrected without delay. Temporary traffic signals not in use shall be covered or removed.

B. The Contractor shall be responsible for the procurement of and payment for electric power for temporary traffic signals.

PART 3 EXECUTION

3.01 COORDINATION

A. The Contractor shall provide and maintain in safe condition such temporary facilities for vehicular and pedestrian traffic as may be necessary to provide safe vehicular and pedestrian ingress and egress for all property adjacent to the improvements. Such access shall be provided at all times unless workers or machinery are in the immediate area. Access shall be provided to all properties at the end of the Work day.

B. When the street under construction is being used by vehicular traffic including periods of suspension of the Work, the Contractor shall maintain that portion of the street or highway being used to ensure that it is smooth, free from holes, ruts, ridges, bumps, and dust.

C. The Owner will enter upon that portion of a project, where the Contractor is responsible for maintaining through traffic on part or the entire project, to place abrasives at its own expense, as may be considered advisable.

1. The Contractor shall be responsible for the removal of abrasives placed, for which no claim for additional compensation shall be allowed nor shall the Contractor be relieved in any way of his obligation for maintenance of traffic.

D. The Owner will provide for the necessary maintenance of public streets or highways which are used as detour beyond the Work limits of the contract.

3.02 TRAFFIC CONTROL

A. Barricades, vertical panels, and cones shall be protected by adequate advance warning construction signs.

B. Contractor shall provide any other lights, barricades, etc., that may be needed for the protection of pedestrian traffic in all areas where materials are stored.

C. Road Closed - When a road is permitted to be closed to traffic, the Contractor shall provide, erect, maintain, and subsequently remove approved traffic control devices, barricades, and suitable and sufficient red or yellow lights.

3.03 TRAFFIC MAINTAINED

A. Where the street under construction is being used by vehicular traffic, including periods of suspension of the Work, the Contractor shall furnish and maintain pavement markings, lights, warning signs, road construction traffic maintained signs, and end construction signs, barricades, temporary guardrail, and such other traffic control devices, and flaggers as may be necessary to maintain safe traffic conditions within the Work limits.

B. Existing signs and traffic control devices within the Work limits shall remain in use during the construction period. If the Contractor needs to relocate or modify permanent signs and other traffic control devices as a consequence of his work, he shall provide suitable supports and may modify the devices with prior approval of the Engineer and the concurrence of the maintaining agency. Routine maintenance of permanent traffic control devices will remain the responsibility of the maintaining agency.

C. The function of existing Stop or Yield signs shall be retained at all times although their position may be adjusted. Existing signs that must be relocated laterally shall be placed in accordance with the MUTCD.

D. When an existing signal operation must be interrupted for a period, the Contractor shall provide a temporary traffic control method.

E. The Contractor shall obtain the approval of the Owner and Engineer before closing a traffic lane or establishing a one-way traffic operation.

F. Flaggers:

1. Whenever one-way traffic is established, at least two flaggers shall be used and signs, cones, barricades, and other traffic control devices shall be erected by the Contractor in accordance with the MUTCD. The Contractor shall maintain positive and quick means of communication between the flaggers at the opposite ends of the restricted area.

2. Flaggers shall be equipped according to the standards for flagging traffic contained in the MUTCD. At night, flaggers' stations shall be adequately illuminated.

3. The Contractor may, in lieu of flaggers, or supplementing them, furnish, install, and operate a temporary traffic signal or signals, for the purpose of regulating traffic.

3.04 RESERVED

PART 4 SPECIAL PROVISIONS

4.01 SPECIAL REQUIREMENTS

A. A construction site plan shall be submitted at the Preconstruction Meeting to approve of contractor parking areas, lay down areas, and office/trailer.

4.02 RESTORATION OF PAVEMENT SURFACES OUTSIDE THE ZONE OF INFLUENCE

A. Contractor shall restore all damaged pavement surfaces in streets used by the Contractor for moving materials and equipment to and from the construction area and streets used for bypassing or detouring traffic around the construction area.

B. Materials used in replacing damaged areas of the road shall be as specified in Section 02600 of these Specifications.

C. The pavement shall be restored with pavement of the same type and thickness as the existing pavement, in accordance with Section 02600 of these Specifications.

END OF SECTION

SECTION 01565
TEMPORARY RESTORATIONAND MAINTENANCE OF PAVEMENTS, CURBS, AND WALKWAYS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes temporary restoration and maintenance of pavements, curbs, and walkways.

B. Restoration - The Contractor shall promptly restore as herein specified all curbs, walks, driveways, and roadways affected by the Work done under this Contract as soon as any sufficient portion thereof has been completed. Such temporary restoration shall be maintained in satisfactory condition until the permanent restoration work replaces the temporary section.

C. Maintenance:

1. All temporary pavement, sidewalks, and other pavements affected by the Contractor's operations shall be maintained by the Contractor at his expense in a suitable and safe condition for traffic until permanent replacement is to be made.

2. This Section includes maintenance in or along streets in which construction is taking place; streets used for moving materials and construction equipment to and from the construction area; and streets used for bypassing or detouring traffic around the construction area.

PART 2 PRODUCTS

2.01 BASE AND SURFACE MATERIALS

A. Base and surface materials shall be in conformance with Section 02600 of these Specifications unless otherwise shown on the Drawings.

PART 3 EXECUTION

3.01 CONSTRUCTION OF TEMPORARY PAVEMENT, CURBS, AND WALKS

A. Preparation of Subbase - Before laying any pavements, sidewalks, or curbs, the trenches shall be compacted and all resulting holes and depressions shall be filled and tamped solid.

B. Curbs - All curbs required to be reset temporarily shall be placed in their original position or as directed but the Contractor will not be required to set them in concrete.

C. Sidewalks - All sidewalks disturbed shall be temporarily restored immediately upon the placing of the backfill either by relaying the old sidewalk pavement, placing 4 inches of aggregate base, laying a pavement of wooden planks 2-inch-thick, suitably fastened, and flush with the adjacent sidewalk, or otherwise as directed. Permanent sidewalks shall be replaced as soon as possible.

D. Pavement - Temporary pavement shall consist of aggregate base course and bituminous surface treatment as specified below:

1. Subgrade - The subgrade for the temporary pavement shall be thoroughly rolled or rammed and brought to the required grade and cross section to receive the pavement. The subgrade for pavements over trench openings large enough to be compacted with a roller shall be rolled to a firm unyielding surface with an approved power roller weighing not less than 10 tons. For smaller trench openings, the subgrade shall be thoroughly rammed.

2. Aggregate Base Course - The aggregate base course shall be 8-inch-thick and shall conform with all requirements of MDOT Item 3.01 Aggregate Base (22A Series).

3. Bituminous Seal Coat - After the aggregate base course has been prepared, a bituminous seal coat consisting of a prime coat and one application each of bituminous material and coarse aggregate shall be applied. All Work and materials shall conform to MDOT Specifications for Seal Coat, Item 4.06. A prime coat of MC-30 or MC-70 shall be applied upon the base course at the rate of 0.3 to 0.5 gallon per square yard. The minimum curing period for the prime coat shall be 24 hours. After the prime coat, has properly cured, a bituminous surface coat of RC-800 or RS-2a shall be applied at a rate of 0.20 to 0.45 gallon per square yard. After application of the surface coat, No. 25A aggregate shall be applied at a rate of 20 to 30 pounds per square yard and rolled.

3.02 SEASONAL LIMITATIONS FOR TEMPORARY PAVEMENT CONSTRUCTION

A. Weather limitations for placing bituminous seal coat shall conform to MDOT 4.06.10. Between paving seasons the Contractor shall place 8 inches of aggregate base and maintain it until seal coat can be applied.

B. When time restrictions are not in effect the Contractor shall prepare the base and immediately place temporary or permanent pavement surface.

3.03 MAINTENANCE – EXISTING AND TEMPORARY PAVEMENTS

A. All existing temporary pavement and sidewalk shall be maintained by the Contractor at his own cost and expense in a suitable and safe condition for traffic until permanent replacement is to be made, or the Work finally accepted. Any depressions which develop shall be acceptably repaved when directed. Spots in the pavements which show signs of deficient bitumen or raveling shall be repaired by hand, and if deemed necessary, pavement shall be reconstructed in part or in whole as directed.

3.04 SEASONAL LIMITATIONS FOR MAINTENANCE OF BITUMINOUS PAVEMENTS

A. During that time of year when asphalt concrete cannot be placed in conformance with MDOT Specifications, the Contractor shall remove loose material from holes and fill depressions in the pavement with cold patch material as required to maintain the road surface in a condition acceptable to the Owner.

B. As soon as weather conditions permit, the Contractor shall remove the cold patch and place bituminous concrete in accordance with Section 02600.

3.05 PERFORMANCE

A. If, in the opinion of the Engineer, proper maintenance of traffic facilities and proper provisions for traffic control are not being provided by the Contractor, the Engineer may take the necessary steps to place them in proper condition, and the cost of such services will be deducted from any money which may be due or become due the Contractor.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 01568
POLLUTION CONTROL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the requirements for pollution control.

PART 2 PRODUCTS

2.01 GENERAL

A. Dust palliatives shall conform to MDOT Item 922.08.

PART 3 EXECUTION

3.01 MICHIGAN GENERAL REQUIREMENTS

A. The Contractor is responsible for following an erosion control plan in accordance with permits required under Act 451, Part 91, as amended (Soil Erosion and Sedimentation Control), Part 303 (Wetland Protection, formerly Act 203), Part 301 (Inland Lakes and Streams, formerly Act 346), Part 31, (Water Resources Protection, Floodplain Regulatory Authority, formerly Act 245 as amended by Act 167), and Part 31 (Water Resources Protection), National Pollutant Discharge Elimination System (NPDES). Secure Federal Section 404, Clean Water Act of 1972, permits, if required. Provide temporary and permanent erosion and sedimentation controls according to the permits.

B. It shall be the responsibility of the Contractor to prevent or limit pollution of air and water resulting from his operations.

C. The Contractor shall perform Work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems, and to prevent dust attributable to his operations from entering the atmosphere.

D. Water containing suspended material from any part of the Contractor's operations shall be clarified before discharging to drains or streams.

E. No fill, topsoil, or heavy equipment shall be stored within 200-feet of a stream bank or within the drip line of a treed area.

F. Excess soil that is stockpiled shall be removed or regraded within 15 days of the completion of construction.

3.02 STREETS, SIDEWALKS AND DRIVEWAYS

A. Streets, haul roads, and detours and bypass roads shall be swept by automatic self-contained sweepers.

B. Excessive dirt on pavements shall be removed by means of hand shoveling or appropriate mechanical equipment and the area swept as directed above.

C. Sidewalks and driveways shall be cleaned by means of shovels and hand brooms or appropriate mechanical equipment.

D. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with calcium chloride dust palliative.

E. The Contractor shall comply with the above requirements on a daily basis. If the Contractor fails to perform the above Work in a satisfactory manner, all Work, except cleanup operations, shall be stopped until the Contractor has complied with the above requirement.

3.03 EROSION AND SEDIMENT CONTROL

A. The Contractor shall initiate appropriate vegetative practices on all disturbed areas to remain dormant (undisturbed) for more than 45 days within seven days.

1. Such practices may include: temporary seeding, permanent seeding, mulching, matting sod stabilization, vegetative buffer strips, phasing and protection of trees.

B. Permanent or temporary soil stabilization shall be applied to disturbed areas within seven (7) days after final grade is reached on any portion of the Site.

C. When seasonal conditions prohibit the application of temporary or permanent seeding, non-vegetative soil stabilization practices, such as mulching and matting, shall be used.

D. A stabilization construction entrance shall be provided to reduce vehicle tracking of sediment. The paved street adjacent to the Site entrance shall be swept a minimum of daily, or as needed, to remove any excess mud, dirt, or rock being tracked from the Site.

1. Dust and sediment along any street due to construction on this Site is to be swept a minimum of once at the end of the day or as necessary to prevent a build-up of dust and soil on the pavement surface.

E. Dump trucks hauling from the construction site shall be covered with a tarpaulin.

F. No more than 200-feet of trench shall be open at any given time. Trench opening, laying of pipe, and backfilling should occur so as to minimize the amount of disturbed area.

G. The Contractor shall minimize the width of his work area.

H. Existing trees, shrubs, and other ground cover vegetation shall be preserved where possible. Tree removal will be limited to that necessary for construction and will be

limited further to the permanent easement wherever possible. No tree removal will be permitted outside the temporary easement.

I. Storm water runoff and natural stream flow shall be intercepted or diverted when originating upgrade away from the construction site so as to minimize the amount of flow over the construction site.

J. All dewatering flows are to be settled in siltation basins or directed through filters before discharge to stabilized sites, such as stream or storm sewers, and not onto exposed soils, stream banks, or any other sites where the flow could cause erosion.

K. When construction occurs near storm sewer inlets, erosion control measures such as inlet filters or hay bales shall be used to prevent silt from entering the storm sewers.

L. The clean-up and disposal of excess excavated material shall be done as soon as practical after laying of the pipe. However, clean-up work shall not fall behind the pipe laying more than 800-feet. Should the Contractor not keep his clean-up within the aforementioned distance, Work shall stop until the clean-up work is accomplished.

3.04 MICHIGAN SEDIMENT CONTROL

A. Contractor shall control erosion and trap sediment from all sites remaining disturbed for more than 14 days. Such practices shall include among others, sediment traps, sediment basins, silt fences, and storm drain inlet protection. Silt Fence Fabric shall be in accordance with MDOT Item 910.04 Silt Fence Geotextile.

B. Timing - Sediment control structures shall be functional throughout earth-disturbing activity. Sediment ponds and perimeter sediment barriers shall be implemented as the first step of grading and within seven days from the start of grubbing. They shall continue to function until the upslope development area is restabilized.

C. Settling Ponds - Concentrated storm water runoff from disturbed areas flowing at rates which exceed the design capacity of sediment barriers shall pass through a sediment settling pond. The facility's storage capacity shall be 67 cubic yards per acre of drainage area.

D. Sediment Barriers - Sheet flow from runoff from denuded area shall be intercepted by sediment barriers. Sediment barriers, such as sediment fences or diversions directing runoff to settling facilities, shall protect adjacent properties and water resources from sediment transported by sheet flow.

E. Other erosion and sediment control practices shall prevent sediment-laden water from entering drain systems. Unless the storm drain system drains to a settling pond. These practices shall divert runoff from distributed areas and steep slopes where practicable and stabilize channels and outfalls from erosive flows.

3.05 RESERVED

3.06 RESERVED

3.07 PROHIBITED CONSTRUCTION ACTIVITIES

A. Disposing of excess or unsuitable excavated material in wetlands or floodplains, even with the permission of the property owner.

B. Locating stockpile storage areas in environmentally sensitive areas.

C. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, any wetlands, any surface waters, or outside the easement limits.

D. Pumping of sediment-laden water from trenches or other excavations directly into any surface waters, any stream corridors, any wetlands, or storm sewers; all such water will be properly filtered or settled to remove silt prior to release.

E. Discharging pollutants such as chemicals, fuels, lubricants, bituminous materials, raw sewage and other harmful waste into or alongside of rivers, streams, impoundments, or into natural or man-made channels leading thereto.

F. Permanent or unspecified alteration of the flow line of any stream.

G. Damaging vegetation outside of the construction area.

H. Disposal of trees, brush, and other debris in any stream corridors, any wetlands, any surface waters, or at unspecified locations.

I. Open burning of project debris without a permit.

J. Discharging injurious silica dust concentrations into the atmosphere resulting from breaking, cutting, chipping, drilling, buffing, grinding, polishing, shaping or surfacing closer than 200 feet to places of residences or places of human occupation.

K. Storing construction equipment and vehicles and/or stockpiling construction materials on property, public or private, not previously specified on the Drawings or not authorized by the Owner or Engineer for such purpose.

L. Running well point or pump discharge lines through private property or public property and rights-of-way without the written permission of the property owner and the consent of the Engineer.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 01800
CONSTRUCTION SURVEY WORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all labor, materials, equipment, and services necessary for the completion of Construction Survey Work in accordance with the Contract Documents.

B. This Work consists of the layout of all lines and grades shown on the Drawings or as altered or modified by the Engineer, control survey and of miscellaneous survey work related to construction of the project.

1.02 PROTECTION

A. The Contractor shall protect and preserve the established reference points and monuments.

B. Whenever monuments are encountered in the line of Work, whether shown on the Drawings or not, the Contractor shall notify the Engineer in writing at least 24 hours in advance of moving same, and under no circumstances is such a stone or other monument to be removed or disturbed by the Contractor or by any of his men without a written order of the Engineer and only when a registered surveyor representative of the Owner is present.

1.03 REPLACEMENT OF LOST SURVEY POINTS

A. Whenever a reference point or monument is lost or destroyed or requires relocation, the Contractor shall, at his own expense, accurately relocate and replace all such points so lost, destroyed, and moved.

1.04 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. Layout Sheets including, but not limited to, Benchmarks both temporary and permanent and Pipeline layout staking.

b. Field Notes and survey log.

B. Contractor shall provide the Engineer and Resident Project Representative, no later than five working days prior to installation, all Logs, reports, field notes, drawings and documentation as specified shown on the Drawings or directed.

C. No pipeline or related Work shall be considered for payment until all logs, reports field notes drawings and documentation as specified, shown on the Drawings or directed has been submitted to the Engineer or Engineers representative.

PART 2 PRODUCTS

2.01 CONSTRUCTION STAKING

A. All construction points shall be marked with a wooden hub and nail or a PK nails in concrete and asphalt pavements and walks.

B. All points located in areas of heavy underbrush, inaccessible or limited site distance shall be identified with a wood lath extending a minimum of 3 feet above the ground.

C. All points located in paved surfaces shall be clearly marked with paint. Contractor shall obtain written permission from owner to use paint for marking.

PART 3 EXECUTION

3.01 COORDINATION

A. The Contractor shall provide field forces necessary to lay out the location, alignment, elevation, and grade of the Work shown on the Drawings and in conformance with the control points and benchmarks shown on the Drawings.

B. The Contractor shall use competent personnel and suitable equipment for the layout of the Work required. If the layout Work involves more than a few simple distance and elevations from established reference points, the Contractor shall employ a Registered Surveyor to supervise the layout Work.

C. Contractor shall furnish the necessary labor to assist the Engineer in checking the installation, if required.

3.02 EXISTING CONNECTION POINTS

A. The Contractor shall verify critical elevation points of the existing utilities prior to commencing installation of Work. Critical points shall include all points where new Work connects to existing utilities and existing utilities that could be conflicts with Work. All data shall be provided to the Engineer before commencing Work.

3.03 RIGHTS-OF-WAY AND EASEMENTS

A. Rights-of-way or easement(s) shall be staked at points along the boundaries so that at least two stakes can be seen distinctly from any point along the boundary line. The staking shall not exceed 200-feet in any direction. All points of change in width or direction of the rights-of-way or easement(s) boundary line shall be staked.

B. When the Contractor performs construction and the zone of influence is within 10-feet of a rights-of-way or easement(s) boundary line, they shall place stakes properly

identifying points of change in width or direction of the boundary line and at points along the boundary line not to exceed 25-feet.

3.04 PAVEMENT

A. The Contractor shall establish a layout for location and grade on both sides of the road and 5-feet off the edge of the pavement or back of curb. Layout line shall consist of stakes set at station intervals necessary for the topography and environment to assure conformance to planned line and grade. Stakes shall be set at a minimum every 50-feet, at all vertical and horizontal points of curvature and points of tangent, and at all vertical high or low points.

B. Stakes for line and grade of pavement and curb shall be set at station intervals necessary for the topography and environment, not to exceed 50-feet, and at low and high points of vertical curves to assure conformance to planned line and grade.

3.05 PIPE IN OPEN CUT

A. The Contractor shall utilize a laser beam for establishing line and grade when installing pipeline in open-cut construction. In order to maintain control during pipeline installation and to obtain the required field data for the record documents the Contractor shall establish construction and layout stakes. These stakes shall be based on the contract documents and the survey control data as provided by the Engineer.

B. The construction staking shall be placed along the pipeline route at and at location of new manholes, valves, deflections both vertical and horizontal and as specified, shown on the Drawings or as directed. All construction layout stakes shall be offset at a minimum of 10-feet and at a right angle to the pipe line route. Layout shall be referenced to the downstream manhole or valve, in addition it may reference survey of baseline stationing.

C. Contractor shall provide to the Engineer, no later than five working days prior to the installation of the pipeline, all information of the completed construction layout staking. This information shall include but not be limited to stationing, elevations, control points, project coordinates, offset direction and distance for all deflections both horizontal and vertical, manholes and all other points as specified, shown on the Drawings and directed by the Engineer.

D. The grade of pipe in open-cut, whether placed by laser beam or other approved methods, shall be checked using surveying equipment. The Contractor shall have a surveyor’s level and level rod on the Site at all times when pipeline and appurtenances are being installed. The level rod shall be equipped with an attached “shoe” extension on the bottom for placing on the pipe invert. The pipe invert elevation shall be checked at a maximum of 50-feet intervals or more often as directed by the Engineer. Checks will be performed by the Contractor and results, including but not limited to layout station shall be recorded in contractor’s field log.

E. The Contractor shall furnish all equipment and labor and check his alignment from the offset stakes. Contractor shall record all information in the log.

F. Any inspection or checking of the Contractor's layout by the Engineer shall not relieve the Contractor of his responsibility to secure the proper dimensions, grades, and elevations of the Work.

3.06 RESERVED

3.07 RESERVED

3.08 LOCATION OF STRUCTURES AND UNDERGROUND PIPING

A. The location of new structures and underground utilities shall be based on the dimensions, coordinates, and requirements shown on the Drawings or specified.

B. If it is stated on the Drawings or specified that the location and/or elevation of the new structure or underground piping shall depend on the location of existing underground or otherwise hidden facilities, those existing underground or hidden facilities shall be located by the Contractor prior to his determination of the location and/or elevation of the new facilities. This requirement shall override any other specific location dimensions or coordinates shown on the Drawings for that structure or piping.

C. If the location or elevation determined by the Contractor, in accordance with the above requirements, appears to cause conflicts with existing structures or utilities or appears to potentially cause functional issues with either the existing or new structures or utilities, the Contractor shall notify the Engineer immediately.

D. In no case, shall coordinates or other location information be extracted or interpolated from the electronic CAD files that may be provided to the Contractor by the Owner or Engineer without the specific approval of the Engineer.

3.09 CURB AND GUTTER ELEVATIONS

A. In locations where the existing curb and gutter shall be removed as part of the Work, the Contractor shall be responsible for reconstructing the existing curb and gutter to match existing alignment, elevations and grades. The Contractor shall be responsible for collecting existing curb and gutter elevation information prior to commencing the Work.

3.10 BENCHMARKS/VERTICAL CONTROL

A. Benchmarks have been set for survey and construction reference purposes.

B. The Contractor shall protect and transfer these benchmarks as needed to complete the Work.

3.11 HORIZONTAL CONTROL

A. The centerline stationing provided is not based upon physical control points found or established as part of the design.

B. The Contractor shall establish horizontal control as necessary.

PART 4 SPECIAL PROVISIONS

4.01 REGISTERED SURVEYOR

A. The Contractor shall employ the services of a registered surveyor for the initial layout and staking of the project. The Registered Surveyor shall be utilized at any time when reestablishing control points, elevations and on any redesign or extension of the Work. All survey Work shall be as specified, shown on the drawings or as directed.

END OF SECTION

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SECTION 02100
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes grubbing, scalping, and otherwise clearing of the construction site in accordance with the Drawings and as specified herein or ordered.

B. This Work includes the removing and disposing of all trees, stumps, vegetation, and debris as necessary to accommodate new construction or to recontour the Site, and the preservation of all vegetation and other objects designated to remain.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. Spoil Site Permit - When the material and debris resulting from the clearing and grubbing operations are disposed of at locations off the project, the Contractor shall obtain and submit as specified written permission from the owner of the property upon which the material and debris are to be placed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Paint required for cut or scarred surfaces of trees or shrubs designated to remain shall be a suitable asphaltum base paint.

PART 3 EXECUTION

3.01 COORDINATION

A. Clearing and grubbing shall be performed only after the Site has been surveyed and staked as required and in accordance with Section 01800.

3.02 PREPARATION

A. The Contractor shall protect and preserve all land survey monuments or property corners along the line of his work.

1. Where monuments, irons, or property corners are disturbed or removed due to operations under this Contract, the Contractor, at his own expense, shall employ the services of a registered land surveyor to establish, reset or replace such monuments, irons, or property corners.

B. The Contractor shall not damage or destroy trees or shrubs nor remove or cut them without authorization by the Owner. All trees and shrubs except those ordered to be removed shall be adequately protected by the Contractor. No excavated material shall be placed so as to damage such trees and shrubs.

1. Trees and shrubs damaged by the Contractor shall be replaced with new stock of similar size and age, or with other stock size and age satisfactory to the Owner, at the proper season, and at the sole expense of the Contractor. Scarred surfaces shall be treated as indicated in Part 2.

C. When or where any direct or indirect damage is done to public or private property resulting from Contractor's operations, such property shall be restored by the Contractor, at his expense, to a condition equal or better than that existing before such damage was done or the Contractor shall make good such damage in manner acceptable to the owner of the property.

D. Prior to clearing and grubbing operation, the Owner, Contractor, and Engineer shall walk the site to designate the trees to be removed or to be protected. Trees shall be marked with paint and a universally accepted designation.

3.03 CLEARING AND GRUBBING

A. Only those trees and shrubs shall be removed that are in actual interference with excavation or grading work and such removal shall be subject to approval by the Owner. The Owner reserves the right to order additional trees or shrubs removed at no additional cost if, in his opinion, they cannot be maintained or have been damaged by the Contractor's operations.

B. All trees, stumps, vegetation, and debris not designated to remain shall be cleared and/or grubbed.

C. In locations to be seeded, stumps, roots, and other protruding obstructions shall be removed to a minimum of 6 inches below the final ground surface.

D. At all times, the Contractor shall remain within the property lines and/or easement areas.

E. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with Section 02200.

3.04 SCALPING

A. Areas of excavation or embankment shall be scalped of brush, roots, sod, grass, crop residue, decayed vegetable matters, and other organic materials.

B. Scalping depth shall be only as required to remove the above. Scalping of topsoil is not included under this Section.

3.05 DISPOSAL OF DEBRIS

A. Debris resulting from the clearing and grubbing operations shall be disposed of at designated spoil sites in a legal manner, in full compliance with applicable codes and ordinances.

3.06 TREE AND VEGETATION REPAIR

A. The Contractor shall employ an arborist where necessary for the repair and protection of a tree and vegetation

B. Contractor shall repair injuries to bark, trunks, limbs, and roots of remaining vegetation by properly dressing, cutting, pruning, bracing and painting utilizing tree surgery methods, tools and materials recommended by the Arborist.

PART 4 SPECIAL PROVISIONS

4.01 TREE REMOVAL

A. All trees to be removed shall be removed between October 1 and March 31.

B. A tree is defined as a live, dying or dead plant with a minimum diameter of 3 inches with snags at 4-feet above the ground surface and a minimum height of 12-feet above the ground surface.

END OF SECTION

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SECTION 02110
REMOVAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes demolition of existing structures and removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Information for the Record:

a. The Contractor shall submit, as specified, a copy of a signed permit from the owner of the property upon which the debris, removed under this Section, will be disposed

b. Dust and noise control measures

c. Record documents, in accordance with the General Conditions, and photograph or video recording indicates the location of, but not limited to, the following existing, new, and abandoned:

1) Utilities.

2) Mechanical.

3) Electrical.

4) Structural.

5) Any embedded items.

d. Inventory and documentation list for removed and salvaged materials for the Owner.

1.03 QUALITY ASSURANCE

A. Contractor shall execute the Work in compliance with all federal, state, and local codes. Any removal or demolition shall not leave the Owner in violation of any such regulations or codes unless approved by the Owner and Engineer.

1.04 PROTECTION

A. Structures shall be removed in such a manner as not to damage any portions of the existing structure which are to remain in place.

PART 2 PRODUCTS

2.01 RESERVED

PART 3 EXECUTION

3.01 COORDINATION

A. Demolition work extending beyond the limits as specified, shown on the Drawings, or as required, will be considered unauthorized. The Contractor, at no additional cost to the Owner, shall repair said damage to a condition equal to or better than existed prior to commencement of the Work.

B. Existing structures and equipment which are damaged in appearance or function by performance of demolition work shall be replaced or repaired, at Owner's discretion and to an approved condition, by the Contractor at no increase in Contract Price.

3.02 PAVEMENTS, SIDEWALKS, CURBING AND SIMILAR STRUCTURES

A. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat, and free from chipped or damaged edges.

B. For removal of non-reinforced concrete, the minimum depth of saw cut shall be 3 inches.

C. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut the steel unless specified otherwise.

D. If the concrete is coated with a bituminous surface or other material, the depth shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

3.03 EXCAVATION OF RIGID PAVEMENT

A. The Contractor shall excavate rigid pavement, consisting of concrete or concrete base with a wearing surface of brick or bituminous concrete, wherever such excavation is required for the purposes of this Contract.

B. Pavement shall be excavated to neat lines and, unless otherwise specified in Part 4 of this Section, only to widths required for trenches for pipe laying and for construction of structures. Adequate provision shall be made to prevent settlement and breakage of pavement beyond the approved limits of excavation. Concrete pavement and sub-base shall be cut with a concrete saw in conformance with Subsection 3.02.

3.04 MANHOLES, CATCH BASINS, INLETS AND SIMILAR STRUCTURES

A. Existing manholes, catch basins, inlets, and similar structures designated to be removed shall be completely removed.

B. Manholes, catch basins, inlets, and similar structures designated to be abandoned shall be removed to an elevation of at least 3 feet below the finished subgrade or ground surface. The remaining void shall be filled with special backfill material compacted to 100% optimum density per ASTM D698 or controlled density fill, CDF if permitted by the Engineer. All sewer openings in manholes located on sewer lines that are not to be filled, shall be plugged with 8-inch minimum thickness masonry plug.

C. Sewers designated to remain in service and connected to structures indicated to be removed or abandoned shall be rebuilt through the area with new pipe. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.

D. All castings or hydrants salvaged from abandoned or removed structures shall remain the property of the Owner, if requested by the Owner, and shall be cleaned and transported by the Contractor to a site designated by the Owner or incorporated in the Work where called for on the Drawings, scheduled, or so directed. If Owner decides salvaged materials are not wanted, the Contractor shall dispose of them at no additional cost to the Owner.

3.05 GROUT-FILLED ABANDONMENT OF PIPE, CONDUIT AND SIMILAR STRUCTURES

A. Ends of sewer designated to be abandoned shall be sealed with approved masonry bulkheads or factory caps and plugs.

B. Contractor shall determine and modify, as necessary, the mix of the flowable fill material to satisfactorily fill the entire abandoned sewers and structures. ACI 229R-99 Table 5.1 provides examples of acceptable mix designs.

C. Contractor may need to include fill holes and vent pipes to assure thorough filling. The locations of grout tubes, vents and inspection ports for grout filling pipes to be abandoned shown on the Drawing shall be considered the minimum number. The Contractor may choose to provide more grout tubes, vents, and inspection ports at no additional cost.

D. Quantities of flowable fill material used to fill the conduits shall be monitored continuously during the placement.

E. Bulkheads shall be installed as shown on plans and as needed by the Contractor’s method to completely fill the abandoned sewers.

F. Sites disturbed by the grout-filled abandonment work shall be restored as part of this Work.

3.06 GUARDRAIL AND FENCE

A. Where so required by the Drawings, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.

B. Wood posts and other materials not considered salvageable by the Owner shall be disposed of by the Contractor.

3.07 SUPERSTRUCTURES, TANKS, CHAMBERS AND SIMILAR STRUCTURES

A. Care shall be used in demolishing structural elements which are continuous with structural elements remaining in service. Unless otherwise permitted by the Owner, concrete and masonry shall be cut through entirely with a masonry or concrete saw before removing the unwanted portions.

B. Methods and equipment used in demolition work shall be chosen so the structural integrity and water tightness of both new construction and existing plant structures remain unimpaired by the performance of the demolition work.

C. Portions of underground structures which are in the way of new sewers, piping, and structures shall be removed from the area of conflict to a distance not less than 6 inches from any point of the new construction.

D. Care shall be used when removing existing concrete from around reinforcing steel which must be used for securing new concrete. If this reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate embedment length in the new concrete, as approved by the Engineer.

3.08 EQUIPMENT REMOVAL

A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall remain the property of the Owner and shall be stored at a site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.

B. See Section 16010 for removal of electrical equipment and appurtenances.

C. The Contractor shall replace, at no cost to the Owner, equipment designated to be turned over to the Owner that is lost or damaged.

3.09 RESERVED

3.10 DISPOSAL OF DEBRIS

A. All debris resulting from demolition operations; i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, equipment, etc., shall be trucked from the Work site by the Contractor and disposed of at spoil sites in a legal manner, in full compliance with applicable codes and ordinances.

B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely cleaned up.

3.11 BACKFILLING

A. All trenches, holes, and pits resulting from the removal and abandonment of any structure or obstruction shall be backfilled and compacted in accordance with the requirements of Section 02200.

3.12 MAINTAINING OF PLANT OPERATIONS

A. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner which results in no interruption of treatment operations beyond that provided for and approved by the Owner and regulatory agencies. The date and time of commencing the separate items of demolition work shall be submitted to the Engineer for review, and no demolition work shall commence until the Engineer's approval of date and time is given.

B. All equipment, labor, and material costs which are made necessary by the requirements of the Sequence Plan, shall be borne by the Contractor.

3.13 USE OF EXPLOSIVES

A. The use of explosives for the Work of removal of structures and obstructions is PROHIBITED.

3.14 PIPING REMOVAL

A. At the location where pipe removal stops, the remaining pipe end shall be capped. The cap must be pressure tight and restrained from movement due to pressures inside the pipe.

B. Piping removal includes, but not limited to, all hangers, stands, and anchoring devices.

3.15 OPENINGS AND PATCHING

A. The Contractor shall fill all openings created by equipment, piping, and conduit removals.

B. The Contractor shall patch any marred surfaces created by equipment and piping removals.

C. All filling and patching work shall be performed in accordance with the specifications.

D. All anchor bolts shall be removed and holes filled or cut off flush.

PART 4 SPECIAL PROVISIONS

4.01 BURIED SANITARY SEWER AND WATER MAIN REMOVAL

A. As shown on the Drawings, existing water main or sanitary sewer main piping, accessories, and appurtenances shall be removed within limits shown on the Drawings or as specified.

B. The removal shall include removal and disposal or aggregate backfill, pipe bedding and control density backfill.

C. Existing pipe removed shall become the property of the Contractor and shall be properly disposed of in accordance with the requirements of this Section.

D. At locations where the pipe removal is terminated, a water-tight sewer plug shall be placed in the end of the pipe to remain.

E. Manholes shall be removed to a minimum of 3 feet below proposed grade.

4.02 VALVES, BOXES AND VALVE STRUCTURES ABANDONED

A. Manholes and valve box castings to be abandoned in place shall be removed to 18 inches below final grade and filled with low-strength mortar backfill in accordance to the bottom of the pavement typical section or to 12 inches below final grade in non-paved areas. The pavement section shall be removed and replace an additional 18 inches horizontally outside of the casting area. The void created by the removal of the casting, structure and valve box shall be backfilled to match the surrounding pavement section or as specified for non-pavement areas.

B. Valve boxes shown on the plans may also have existing manhole castings, frames, manhole structures around the existing valves. The abandonment of valves shall include the removal of all existing manhole casting, frame, and structure walls to be specified depths as associated with that particular valve.

C. Valve shall be abandoned in the off position when possible.

4.03 VALVES AND STRUCTURES REMOVED

A. Valves, boxes and structures to be removed shall be removed in their entirety or as approved otherwise by the Engineer.

B. All hydrant valves and boxes shall be removed as part of hydrants specified for removal.

END OF SECTION

SECTION 02200
EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all excavations and related Work for the construction of the designated structures, pipelines, and other incidental Work.

B. Excavation includes the Work of making all necessary excavations for the construction of all Contract Work; of furnishing, placing, and use of sheeting, shoring, and sheet piling necessary in excavating for and protecting the Work and workers; of doing all pumping and fluming necessary to keep the excavation free from water; of providing for uninterrupted flow of existing streams, treatment plant processes, drains and sewers; of damming and cofferdamming where necessary; of supporting and protecting existing structures, pipes, conduits, sewers, culverts of all types of materials of construction, of supporting and protecting railroad tracks, posts, poles, wires, fences, buildings, and other public and private property adjacent to the Work; of removing and replacing existing sewers, culverts, pipelines, and bulkheads where necessary; of removing after completion of the Work all sheeting and shoring not necessary to support the sides of excavations; of removing and disposing of all surplus excavated material or material under structures that does not meet the soil design bearing capacities; of doing all backfilling, of compacting backfill to limits specified or ordered by the Engineer; and restoring all property damaged as a result of the Work involved in this Contract.

C. The Work includes obtaining and transporting suitable fill material from off-site when on-site material is not available.

D. The Work includes transporting surplus excavated material not needed for backfill at the location where the excavation is made, to other parts of the Work where filling is required, or disposal of all surplus on other sites selected by the Owner.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Sieve Analysis (ASTM C136) - One test for each material source.

b. Submit a moisture density curve (ASTM D698) for each type of material used for backfill. Test shall be referenced to appropriate sieve analysis test. The maximum dry weight and optimum moisture content shall be indicated.

c. Controlled Density Fill Material - Design Mix and Certified Test Results.

d. Test results for conformance with specified "Compaction Requirements":

1) Retests shall be referenced to the corresponding failing test.

e. Stripped soil and topsoil test per MDOT 816.

2. Information for the Record:

a. When excess excavated material is disposed at locations off the Site, the Contractor shall obtain and submit written permission, and a release from liability for the material, from the Owner of the property upon which the material is to be placed.

b. Details of the proposed method of installation and construction of dewatering wells.

c. Schedule of the proposed sequence of dewatering well construction.

d. Dewatering logs.

e. Submit method for abandoning dewatering well.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Soil stripped from the Site shall consist of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, litter, ground debris and wood products. The stockpiled soil shall be subject to the approval of the Engineer.

B. Topsoil provided shall be in accordance with MDOT 816 and be loose, friable, loamy soil without admixture of subsoil or refuse. In order for the topsoil to be considered loamy the fraction of topsoil, passing a No. 10 sieve, shall contain not more than 40% clay. Topsoil shall contain not less than 4% nor more than 20% organic matter as determined by loss on ignition of oven-dried samples to constant weight at 212 degrees F.

C. Excess material shall be removed from Site, unless directed otherwise by Owner or Engineer.

2.02 RESERVED

2.03 SPECIAL BACKFILL MATERIAL

A. Special backfill material shall conform to MDOT 902.07 and shall meet the grading requirements Table 902-3, Class II.

B. Shallow spread foundations and footings shall bear on special backfill to the mass undercut as outlined within the drawing set. This material shall extend at a 45 degree

angle from the edge of the foundation to approx. 1 foot above the groundwater elevation and rest on the subbase as described in section 2.07 of this spec.

2.04 AGGREGATE BEDDING MATERIAL

A. Aggregate bedding material shall be well-graded durable crushed gravel, crushed stone or meeting the graduation requirements of MDOT Table 902-1, Class 17A.

B. Aggregate bedding material shall be as follows:

1. For PVC, HDPE or plastic pipe diameters 10 inches and less, bedding material shall be No. 8 (nominal size 3/8-inch to sieve No. 8).

2. For PVC, HDPE or plastic pipe diameters over 10 inches, bedding material shall be No. 67 (nominal size 3/4-inch to sieve No. 4) or No. 8 (nominal size 3/8-inch to sieve No. 8).

3. All other aggregate bedding shall be No. 8, No. 67 or No. 57 stone. No. 57 (nominal size 1-inch to sieve No. 4) shall not be used for bedding PVC, HDPE or plastic pipes.

C. Fine aggregate bedding material shall be natural sand or manufactured sand bedding material meeting the requirements of MDOT Table 902.08 and MDOT Table 902-8.

1. Fine aggregate bedding material shall be No. 9 (2ns to 2ss) or 2ms (nominal size sieve 4 to sieve 100) or Table 902.4..

2. Fine aggregate bedding (sand) is typically used in Michigan. It may also be necessary to use fine aggregate (sand) for ductile iron pipe where the limestone aggregate bedding is corrosive to DIP or the soils are corrosive

2.05 RESERVED

2.06 SLOPE AND CHANNEL PROTECTION

A. Riprap, plain or heavy, shall be in accordance with MDOT 813

B. Crushed aggregate slope protection shall be in accordance with MDOT 813.

C. Dumped rock fill shall be in accordance with MDOT 813.

D. Rock Channel protection shall be in accordance with MDOT 813.

2.07 BELOW GROUND WATER FILL

A. Well graded, coarse crushed aggregate or crushed concrete ranging from 1 to 3 inches in nominal size and containing not more than 7 percent passing the No. 200 sieve shall be installed from undercut elevation to a min. of 1’ above the ground water elevation.

B. The course, crushed material shall be tamped ot charged into the exposed subgrade using the excavator bucket or static rolled until it is stable.

C. The course, crushed material shall be choked with at least 6 inches of dense-graded aggregate such as MDOT 21AA.

1. This is to mitigate the potential migration of overlaying granular fill into the voids of the coarse material.

2. AN approved heavy, non-woven geotextile fabric placed on the surface of the coarse, crushed material may be used in lieu of the dense-graded aggregate.

D. Dewatering will be at the expense of the contractor. A monitoring well OW5 can be used for contractor to plan ground water control methods.

PART 3 EXECUTION

3.01 COORDINATION

A. Test Pits:

1. The Contractor shall perform exploratory test pits as may be necessary or ordered by Engineer in advance of excavation to determine the exact location and elevation of subsurface structures, pipelines, and conduits which are likely to be encountered and shall make acceptable provision for their protection, support, and maintenance in operation. Vacuum excavation (pot hole) may be used if adequate information can be obtained by such method. No additional payment shall be made for test pits.

2. Conflicts with existing utilities not located, as specified, far enough in advance of construction, shall not be considered as a basis for delay claims or additional payment.

3.02 REMOVING AND REPLACING TOPSOIL

A. Removal

1. Excavation for trenches in which pipelines, sewers, conduits and other utilities are to be installed: The Contractor may elect to strip soil and stockpile unless the Contract Documents direct stripping and stockpiling prior to excavation.

2. General excavation, other than trench excavation: The Contractor shall remove, and stockpile the top 12 inches of the existing soils from all areas of construction including, but not limited to, excavation and embankment areas, stockpile sites, construction yard, storage areas, etc.

B. Replacing stockpiled soil and topsoil

1. Trench excavation areas disturbed as a result of trenching operations and which are to be restored with grass or other plantings shall be free of peat, muck,

roots, hard clay, coarse gravel, stones, weeks, tall grass, brush, sticks, litter, ground debris and wood products. The surface shall be mechanically conditioned after removal of debris. After surface is prepared, it shall be covered with topsoil or stockpiled soil material to a minimum depth of 4 inches. Topsoils and stockpiled soil material shall meet the requirements specified herein and be tested.

2. General excavation areas which are to be restored with grass or other plantings shall be free of peak, muck, roots, hard clay, coarse gravel, stones, weeks, tall grass, brush, sticks, litter, ground debris, wood products and construction debris including loose stone. The surface shall be mechanically conditioned after removal of debris. After surface is prepared it shall be covered with stockpiled soil and then have a minimum of 4 inches of topsoil placed.

C. The Work shall be in accordance with applicable portions of MDOT Sections 205.03A.1 and 816.03A.

3.03 GENERAL EXCAVATION

A. All necessary excavation shall be performed to accommodate the completion of all Contract Work.

B. The Drawings show the horizontal and the lower limits of structures, pipelines, sewers and other utilities. The methods and equipment used by the Contractor when approaching the bottom limits of excavation and when trimming the bottom of the excavation to a smooth surface shall be selected to prevent disturbing the soil below the bottom limits of excavation.

C. Excavation which is carried below the bottom limits shall be classified as Unauthorized Excavation, unless said excavation has been authorized by the Engineer prior to each occurrence.

D. Unauthorized excavation shall be filled with CDF material to the bottom limits. Under circumstances where structural integrity is not a factor, the Engineer may allow the filling of unauthorized excavation with pipe bedding material or special backfill material compacted to 100% density, as specified under compaction requirements.

E. Sheeting, Shoring, and Bracing:

1. The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all existing adjacent and neighboring structures and utilities from damage by settlement.

2. Sheeting, shoring and bracing shall be arranged so as not to place a strain on portions of completed Work until the construction has proceeded far enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built Work and adjacent and neighboring structures and utilities.

3. Sheeting, shoring and bracing shall be removed or cut-off at the time of backfilling to avoid problems with finish grade or future excavation.

F. Removal of Water:

1. The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work and shall keep said excavations dry until the structures to be built or pipelines to be placed therein are completed. No water shall be allowed to rise over or come in contact with concrete or masonry until the concrete and mortar has attained a satisfactory set, except in cases where the concrete has been tremied into place with the approval of the Engineer. Water shall not be allowed to rise above the bottom of the bedding stone prior to placing pipe. In waterbearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation free of water and in compliance with government regulations.

2. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property or structures and in compliance with all regulations.

3.04 TRENCH EXCAVATION

A. Excavation for trenches in which pipelines, sewers, conduits and other utilities are to be installed shall provide adequate space for workers to place and joint the pipe properly. The trench shall be kept to a minimum width. The width of trench at the top of the pipe shall comply with the limits specified or shown on the Drawings.

B. Excavation shall be to the depth necessary for placing aggregate bedding material under the pipeline, sewer, conduits and other utilities as shown on the Drawings. If over excavation occurs, the trench bottom shall be filled to grade with compacted aggregate bedding material.

C. The amount of trench open at any one time in advance of completed Work shall be limited to the minimum necessary for conducting laying operations.

D. In general, backfilling shall begin as soon as the pipeline, sewer, conduits and other utilities are in a condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe condition.

3.05 EXCAVATION OF UNSUITABLE MATERIAL

A. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as required by the Engineer. The Engineer may rely upon the independent laboratory retained on this Project when determining unsuitable soil conditions, removal and backfill. Such excavation shall be conducted at a time when the Engineer

and independent laboratory are present and shall not exceed the vertical and lateral limits prescribed by both.

B. The voids left by removal of unsuitable material shall be filled with special backfill, pipe bedding material, or CDF material as listed in Part 4 or as prescribed by the independent laboratory and as approved and ordered by the Engineer. Special backfill or pipe bedding shall be installed as described in this Section and in general shall be compacted to 100% density as specified under compaction requirements.

3.06 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. All excavated materials which are unsuitable for use in backfilling trenches or around structures, and materials excavated that are in excess of that required for backfilling and for constructing fills and embankments as shown on the Drawings, shall be disposed of by the Contractor at his expense and at sites provided by him as may be required, except that the Owner reserves the right to require the Contractor to deposit such surplus at locations designated by the Owner within a five-mile radius of the Work.

B. No surplus excavated material of any class shall be deposited in any stream or watercourse or be dumped on public property without the consent of the Owner. All spoil areas shall be left smooth, level, with drainage to a water course and proper erosion and runoff control shall be used.

3.07 BACKFILL AND COMPACTION

A. Pipe and Conduit Bedding - Unless otherwise directed, pipe, conduits and other utilities shall be installed in specified aggregate bedding material as shown on the Drawings and as specified.

B. Backfilling Under Existing Pipeline, Sewer, Conduits and Other Utilities - Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with aggregate bedding material tamped in place in 6-inch layers to the required density. The aggregate bedding shall extend outward from the spring line of the conduit a distance of 2-feet on all sides and thence downward at its natural slope.

C. Backfilling with Selected Backfill - Unless otherwise specified or directed, material excavated in connection with the Work may be used for backfilling and other filling purposes, if it meets all requirements given elsewhere in this specification for selected backfill. No material shall be used for backfilling that contains stones, rock, or pieces of masonry greater than 12 inches, frozen earth, debris, earth with an exceptionally high void content, organic material, or marl. No large pieces of rock or masonry shall be deposited closer than 24 inches from the completed outside surface of any structure or pipe.

D. Backfill Immediately - All trenches and excavations shall be backfilled immediately after completion of construction therein, unless otherwise directed by the Engineer. Under

no circumstances shall water be permitted to rise in unbackfilled excavation during construction or after pipe has been placed.

E. Backfilling around and over structures, pipelines, conduits and other utilities comprising the Work shall be carefully done by hand and tamped with suitable tools of approved weight when within 2 feet of structures, pipeline, conduit and other utilities. Selected backfill or, where specified, shown on Drawings, or ordered by the Engineer, special backfill material shall be used in this area. The material shall be placed in uniform layers not exceeding 6 inches in depth up each side. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of pipe or structure.

F. Backfilling may be done by machinery after the backfill has been placed and compacted beyond 2 feet horizontally of structures, pipelines, conduits and other utilities and to a minimum depth of 1 foot above the tops of any buried structures, pipelines, conduits, and other utilities. The backfill material shall be deposited in horizontal layers, not thicker than one foot, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case, will backfill material from a bucket be allowed to fall directly on a structure or pipe and in all cases the bucket must be lowered so that the shock of the falling material will not cause damage.

G. Backfilling Under Pavement and Walks - Where existing or new pavement, driveway, parking lot, curb and gutter, or walk is over an excavation, special backfill material shall be used to backfill the entire excavation from the bedding to surface. The material shall be placed and compacted to the required density in accordance with one of the following methods:

1. The backfill material shall be deposited in 6-inch horizontal layers and each layer shall be thoroughly compacted to the proper density by approved compaction method before a succeeding layer is placed.

2. No method of compaction which alters the gradation of the special backfill material or prevents compaction testing by standard testing methods shall be used.

H. Backfilling Under Structures

1. Where structural slabs, mats or footings are to be placed on a backfilled area, special backfill material shall be used unless otherwise noted on the Drawings. The backfill material shall be placed in 6-inch horizontal layers and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. Where backfill is to be placed on undisturbed side slopes steeper than one vertical to six horizontal, steps shall be formed into the slope before each layer of the backfill is placed. These steps shall be cut vertically at no more than 2-feet intervals and shall have a horizontal dimension of not less than 3-feet.

2. Prior to backfilling under structures the natural subgrade shall be evaluated at regular intervals in each direction by the independent testing laboratory to determine that the subgrade can obtain the design bearing capacity given by the "Structural Design Data" table on the Drawings. If the subgrade cannot obtain the design bearing capacity then the testing laboratory shall submit a remedy to the Engineer for approval and for the Contractor to perform.

3.08 COMPACTION REQUIREMENTS

A. In areas to be filled, after the top 12-inches of soil is stripped, then the undisturbed subgrade shall be compacted to not less than 100% of maximum dry density per ASTM D698 (Standard Proctor) prior to placing of fill.

B. Backfill placed under areas receiving concrete slabs, mats, footings, or within the interior of buildings shall be compacted to not less than 100% of maximum dry density per ASTM D698.

C. Backfill placed around structures where other structures, pipelines, or slabs are to be constructed shall be compacted to not less than 100% of maximum dry density per ASTM D698.

D. The material used to construct embankments and fills in locations other than under pavements, walks, structures, or slabs and around and over pipelines, shall be compacted to not less than 95% of maximum dry density per ASTM D698.

E. All other backfill, including backfill around and over pipelines, and backfill around structures not covered in Paragraphs B. and C. above, shall be compacted to not less than 95% of maximum dry density per ASTM D698.

F. The bottom of excavations upon which concrete slabs or structures are to be placed shall be compacted to obtain 100% maximum dry density per ASTM D698 in the top 12 inches.

G. All soil subgrade which will provide bearing support for pavements or curbs, shall be compacted to a width of 6 inches beyond the back of curb and to a depth of 12 inches below the bottom of excavation to a density of not less than 100% of maximum dry density per ASTM D698. All fill below the subgrade shall be compacted to not less than 98% of maximum dry density, unless specified otherwise.

H. Subgrade under the driveways and walks shall be compacted to a depth of 6 inches below the subgrade surface to density of not less than 100% of the maximum dry density determined by ASTM D698.

I. Subgrade under structures shall be compacted to a depth of 12 inches below bottom of excavation surface to a density of not less than 100% of the maximum dry density determined by ASTM D698.

3.09 COMPACTION TESTS

A. Trenches and excavation around structures shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain the required compaction. Any change in the proven method of consolidations will require additional testing and field verification of compaction.

B. Subgrade below pavements, curbs, sidewalks, and structures shall be consolidated as specified. Compaction tests shall be performed to verify specified consolidation.

C. Subsequent tests or series of tests shall be in locations and at depths ordered by the Engineer.

PART 4 SPECIAL PROVISIONS

4.01 FIELD TESTING (MINIMUM REQUIREMENTS)

A. The laboratory shall perform the following field tests:

1. Trench Backfill - One test for every 200 cubic yards of backfill material.
2. Subgrade Compaction - One test for every 300 square yards of subgrade.
3. If directed by the Engineer, additional tests shall be performed for any of the above.

END OF SECTION

SECTION 02550
SANITARY SEWERS AND STORM SEWERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing sanitary sewers and storm sewers.

B. Reconstruction of existing sewers, house connections, and catch basin leads shall be in conformance with requirements of this Section.

C. This Section shall include furnishing and installing all required pipe, bends or beveled pipe, tees, wyes, tee manhole base pipes, bulkheads and stoppers, jointing material, granular material for pipe bedding, concrete used for encasement or bedding, making watertight connections to existing and new sewers and existing manholes, catch basins and inlets, cleaning and testing sewers, removing temporary bulkheads, and other work incidental to the sewer installation unless specifically included under other Items.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's Shop Drawings indicating pipe and joint materials, physical dimensions, and joint details for each size, type, and class of pipe, fittings and specials furnished for the project compliance with specified standards.

b. Manufacturer's concrete design strength and reinforcing steel for RCP.

2. Information for the Record:

a. Manufacturer's certification indicating that the pipe and joints meet specifications for each production run for each size, type, and class of pipe furnished. The Engineer may request test results to verify certification. Certification documents shall be according to the Source Quality Control of this Section.

b. Manufacturer's design calculations to verify basis of design.

c. Manufacturer's installation instructions.

d. The laboratory shall submit test certifications of pipe ordered tested under "Field Quality Control," of this Section.

PART 2 PRODUCTS

2.01 SOLID WALLED PIPES

A. Polyvinyl Chloride (PVC) Sewer Pipe Specifications:

1. For pipe 15-inch diameter and smaller: Pipe, fittings, and jointing systems shall conform to ASTM D3034, except that the standard dimension ratio of the outside diameter of the pipe to wall thickness shall not exceed 26.
2. For pipe 18 inch thru 24-inch diameter: Pipe, fittings, and jointing systems shall conform to ASTM F679 with a SDR 26 wall thickness.
3. Joint systems shall be elastomeric seal (gasket) type. Seals shall conform to ASTM F-477 requirements. Joint materials and testing shall conform to ASTM D3212 requirements.
4. All service connections shall be made using a wye and a bend. Tees shall be used only as directed by the Engineer. Tees and wyes shall be die cast or factory fabricated. All service pipe shall be SDR 35.

2.02 COMPOSITE AND PROFILE WALLED PIPES

A. High Density Polyethylene - (HDPE):

1. High density polyethylene pipe, fittings, and jointing systems shall meet the requirements of ASTM F667 and shall have a smooth interior and be double walled
2. Joints shall be watertight and gasketed.
3. This pipe is only permitted for storm drainage installations.
4. Pipe shall be 12inch ADS N-12 HDPE pipe or equal.

2.03 ACCESSORIES

A. Flexible Pipe Repair Couplings:

1. Flexible repair couplings shall be made of elastomeric polyvinyl chloride boot with series 300 stainless steel shield and clamps. Couplings shall be Strong Back RC series as manufactured by Fernco Joint Sealer Co., Ferndale, Michigan; Logan Clay Pipe Co., Logan, Ohio; Mission Clay Products Corp., or equal.

B. Flexible Watertight Joints:

1. Flexible watertight joints used in connecting to existing sewers shall be a “boot” type sealed to the pipe wall with an internal expanding band and around the connecting pipe with an external adjustable band. Other types of applicable flexible joints may be submitted for approval.

C. Granular Pipe Bedding Material:

1. Granular pipe bedding material shall be as specified in Section 02200.

2.04 REPLACEMENT DRAINS, SEWERS AND APPURTENANCES

A. Vitrified clay pipe sanitary sewers removed or damaged in completed the Work shall be replaced using pipe and joints as specified in this Section. Connections to existing sewers shall be as specified in this Section.

B. Reinforced concrete pipe sanitary sewers removed or damaged in completing the Work shall be replaced using pipe meeting ASTM C76, Cl. IV, unless otherwise indicated and joints meeting ASTM C361. Reinforced concrete pipe storm sewers shall also be replaced with ASTM C76 Cl. IV RCP with joints equal to those of the pipe removed.

C. Nonreinforced concrete pipe removed or damaged in completing the Work shall be replaced using pipe meeting ASTM C14 "Extra Strength Nonreinforced Concrete Pipe." Joints shall be equal to those of the pipe removed. Class IV RCP may be used in lieu of nonreinforced pipe.

D. Manholes, catch basins, and inlets removed or damaged under these Items shall be replaced in conformance with applicable Drawings and Specifications.

E. Driveway culverts removed or damaged in completing the Work shall be replaced with existing pipe, if undamaged, or new pipe and joints matching the existing, unless specified otherwise.

2.05 SOURCE QUALITY CONTROL

A. Pipe Manufacturer's Certification:

1. The pipe manufacturer's certificate shall state that the materials have been sampled and tested in accordance with the provision for and meet the requirements of the designated specification and shall be signed by an authorized agent of the seller or the manufacturer.

2. A test results report shall accompany that manufacturer's certificate. The report shall compare test results to Specification requirements. Test specimens shall be selected in conformance with the designated specification, except that no less than two tests shall be made for each production run of each size, type, and class of pipe furnished, and further, that in case tests are unsatisfactory, additional tests shall be made to the maximum number in the referenced ASTM Specification.

PART 3 EXECUTION

3.01 RESERVED

3.02 PREPARATION OF TRENCH

A. Trench excavation shall conform to requirements of Section 02200.

B. For rigid pipes the width of trench at the top of pipe shall be as shown in the Trench Detail on the Drawings.

C. Unless otherwise indicated minimum trench widths for flexible pipes shall meet the requirements of ASTM D2321 and the Trench Detail shown on the Drawings.

D. Unless otherwise indicated all sewer trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of bedding material as shown on the Drawings and specified herein.

3.03 RIGID PIPE INSTALLATION

A. Pipe trenches shall be excavated to the depth indicated on details to provide adequate depth of bedding and the pipe shall be placed and supported on bedding material the full length of the barrel. Bedding material shall then be placed 4-inch maximum depth along both sides of the pipe and tamped firmly under the pipe haunches. Additional bedding material shall be placed and compacted in 6 inch layers to the height shown on the Drawings or as directed. Hand tampers shall be used for installing bedding material around pipes smaller than 36-inch diameter and mechanical hand tampers shall be used around pipes 36-inch diameter and larger unless otherwise directed by the Engineer. The remainder of the trench shall be backfilled as specified and called for on the Drawings.

B. The laying of pipe in finished trenches shall be commenced at the lowest point, with the bell end or groove end laid upgrade. Pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered to form a sewer with a uniform invert of line and grade shown on the Drawings.

C. Pipe shall be laid to lines and grades by use of a laser beam and checked in conformance with Section 01800. Pipes installed more than 0.04 feet above or below specified elevation shall be removed and reinstalled to grade.

3.04 FLEXIBLE PIPE INSTALLATION

A. Flexible pipe shall be installed in accordance with ASTM D2321. Bedding, backfill, and compaction shall meet the requirements of this Section and Section 02200.

B. Concrete bedding and encasement in lieu of bedding material shall be installed as shown on the Drawings or specified.

C. The laying of pipe in finished trenches shall be commenced at the lowest point, with the bell end or groove end laid upgrade. Pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered to form a sewer with a uniform invert of line and grade shown on the Drawings.

D. Pipe shall be laid to lines and grades and checked in conformance with Section 01800. Pipes installed more than 0.04-feet above or below specified elevation shall be removed and reinstalled to grade.

E. Temporary internal supports shall be used as recommended by the pipe manufacturer. Pipes with 48 inches or larger diameter shall have, as a minimum, struts temporarily inserted at the ends of the pipes. Struts shall be in the vertical position when the pipe is installed in the trench. Struts shall remain in place until after the trench has been completely backfilled.

3.05 PIPE JOINTS

A. O-Ring and Chemically Welded Joints - Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining. Lubricants, primers, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer’s specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a

manner as to obtain a watertight joint. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

B. Flexible Plastic Gasket Joints - Materials used for gaskets shall be as specified in this Section. Cross section size of gaskets and method of installation shall conform to the manufacturer's recommendations.

3.06 CONNECTIONS TO EXISTING SEWERS

A. Unless indicated otherwise new pipe connections through the side of existing sewers shall be made as follows:

1. Vitrified clay pipe, plain concrete pipe, and asbestos cement pipe, 15-inch diameter and smaller, and larger diameter at the option of the Contractor, shall be connected by removing a section of the existing sewer and inserting connecting fittings using specified flexible repair couplings.

2. Reinforced concrete pipe and larger sizes of asbestos cement pipe and plain concrete pipe, unless otherwise shown on the Drawings, shall be connected by coring the existing sewer pipe wall and inserting a flexible watertight joint to receive the new pipe.

3. Polyvinyl chloride pipe, ABS pipe, and ABS truss pipe shall be connected in conformance with the manufacturer's recommendations as approved by the Engineer.

4. Connections shall be made in conformance with the jointing materials manufacturer's recommendations and as directed by the Resident Project Representative.

3.07 FIELD QUALITY CONTROL

A. The Resident Project Representative may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the Contractor's laboratory. The Contractor shall furnish the first test piece or pipe core and any additional samples required because of failures. The Contractor shall pay for tests on the first sample. Should the sample fail to meet specifications, retests shall be conducted by the Contractor's laboratory in conformance with the specifications and shall be at no additional expense to Owner.

B. Deflection of PVC, PE and ABS Composite Piping Sewers:

1. Vertical Ring Deflection - Before final acceptance of sewer lines, all sections of sewer pipe 8 inches and larger specified diameter shall be measured for vertical ring deflection by the Contractor and witnessed by the Resident Project Representative. Maximum deflection under full load shall not exceed 5% of the ASTM designated average inside diameter as determined by the laboratory for the specified piping.

2. Failures - Should a pipe exceed the allowable deflection; the Contractor shall replace those pipes and retest the section.

3. Equipment used in testing shall be go-no-go pull through gauges of a type approved by the Engineer. A metal or plastic gauging ring of diameter equal to 95% of the specified average inside pipe diameter shall be furnished with each gauge.

4. The Contractor shall furnish testing equipment and personnel and perform the required tests. Tests must be witnessed by the Resident Project Representative.

5. Use of mechanical pulling devices is not permitted.

6. Deflection testing shall not be performed until the completed and accepted trench backfill has been in place for at least 30 days.

C. Field Inspection:

1. Individual sections of pipe may be rejected at any time because of defective joints, dimension variations, fractures, cracks, chips, or blisters exceeding the permissible tolerances.

2. Rejected pipe shall be so marked with a lumber crayon or paint and shall be removed from the job site before the end of the following work day.

3.08 TESTS FOR INFILTRATION AND EXFILTRATION

A. Preparation:

1. Before sections of sewers may be tested for infiltration or exfiltration, all house leads from it shall be constructed to limits called for and plugged or capped and all trenches backfilled and compacted to required minimum density.

2. Sewers to be tested shall be clean and free from construction debris. Sand, dirt, concrete, or other materials shall be completely removed in a manner that will not damage the sewer pipe.

3. Pipe joints shall be watertight. The Contractor shall repair manholes and pipe joints as required to stop leaks.

4. Where sewers are above the groundwater table, the Contractor may flood the trench or air test the sewer to find and repair leaks prior to exfiltration tests.

5. The materials and methods for repairing leaks shall be submitted to Engineer: for approval before beginning Work. Chemical grouting of pipes is not acceptable.

B. Inspection:

1. After a sewer has been cleaned and all repairs made as specified, the sewer shall be inspected and approved by the Resident Project Representative before conducting infiltration or exfiltration tests. Sewers shall be approved before any connections are made to or final surface restoration can begin.

2. Sewers shall be inspected using audio-video recording in accordance with the requirements of Section 01820.

3. The Contractor shall furnish all lights, cameras, carts, television, and other equipment and labor required to audio-video record the new sewers or any repaired sewer.

4. The Resident Project Representative may require the Contractor to conduct a television inspection of smaller sewers that appear defective or do not pass infiltration tests.

C. Test Sections:

1. The maximum length of a sewer test for infiltration or exfiltration section shall be 900 lineal feet. Every manhole shall be included in one (minimum) test section.

2. The Contractor shall furnish and install bulkheads, sewer plugs, weirs, water level tubes, lighting, and other equipment required to conduct the tests in locations and as indicated by the Resident Project Representative.

3. Infiltration in accordance with ASTM C969:

a. Where the groundwater level is above the top of the pipe, the sewer shall be tested for infiltration.

b. The Contractor shall plug or bulkhead the sewer to isolate the test section and install a weir in the pipe at the outlet manhole. The weir shall be direct reading of an approved design calibrated to read gallons per day.

c. Where the groundwater level is below the top of the sewer pipe and the trench can be flooded and the level maintained above the pipe (minimum 2 feet of head at the highest point in the pipe being tested) for test period, the Contractor may test the pipe for infiltration.

4. Infiltration in accordance with ASTM C1103 (Precast Concrete Pipe)

a. For precast concrete pipe with a diameter 27 inches and larger the joint acceptance test per ASTM C1103 may be utilized.

b. This test is only acceptable if the groundwater level (pressure) is equal to or less than the test pressure.

1) If the groundwater level (pressure) is above the test pressure and the joint is not leaking, then the joint is acceptable in accordance with ASTM C969.

c. If groundwater level is below the test pressure test the joints in accordance with ASTM C 1103. Air or water are acceptable in accordance with industry practices and the ASTM C1103.

1) The air pressure required for the test shall not exceed 5.0 psig.

d. Failed joints shall be repaired and retested until joint passes test.

5. Exfiltration in accordance with ASTM C969:

a. Where the groundwater level is below the top of the pipe and cannot be maintained above it, the sewer shall be tested for exfiltration.

b. The Contractor shall bulkhead or plug each end of the designated test section and fill with water to the elevation indicated by the Resident Project Representative (minimum 2 feet of head at the highest point in the pipe being tested). Exfiltration will be computed from the loss of water as measured in the manholes.

6. Allowable Leakage:

a. The test in each section shall be continued for at least 24 hours and, if its measured leakage during that period exceeds 100 gallons per inch of diameter per mile of pipe, the Contractor shall locate the points of leakage and make necessary repairs, continuing the Work until leakage is reduced to the permissible maximum as specified.

b. The amount of infiltration allowed for storm sewers shall be limited to reasonable seepage, except that, if specified, the total in any section shall not exceed the amounts allowed for sanitary sewers as hereinafter specified.

c. All visible leaks shall be repaired whether they are less than the allowable leakage. Moisture or visible beads of water on a joint will not be considered a visible leak.

3.09 LOW PRESSURE AIR ACCEPTANCE TESTS

A. Where approved by the Engineer, the Contractor may perform low pressure air acceptance tests in lieu of infiltration or exfiltration tests for pipes 24 inches in diameter or smaller. Test shall be made in accordance with ASTM F1417-Plastic Gravity Sewer Lines; ASTM C924-Concrete (Circular) Sewer Pipe with Gasket.

1. If the air pressure required for the test is greater than 5.0 psig, the low-pressure air acceptance test shall not be used.

B. The Contractor shall furnish all equipment, materials, and labor, and conduct the tests under observation of the Resident Project Representative.

C. Safety:

1. The air test may be dangerous if the line is improperly prepared. All plugs shall be installed and braced in such a manner to prevent blowouts. No one shall be allowed in manholes during testing.

2. Pressurizing equipment shall include a regulator set at the maximum pressure.

D. Line Preparation:

1. Sewers to be air tested shall be prepared and inspected as specified herein for infiltration and exfiltration tests.

2. Where porous pipe materials are used, the pipe walls may be wetted to temporarily reduce the porosity of the material.

3. All pipe outlets shall be plugged, braced, and the joints restrained adequately to prevent blowouts.

E. Test Procedure:

1. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the invert of the pipe.

2. When a constant pressure of 4.0 psig greater than the average back pressure of any groundwater above the pipe is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes to permit temperature equalization.

3. When temperatures have been equalized and the pressure stabilized at 4.0 psig greater than the average back pressure of any groundwater above the pipe, the air supply shall be shut off or disconnected.

4. Decrease the pressure in the sealed line until the continuous monitoring pressure gauge reads 3.5 psig greater than the average back pressure of any groundwater above the pipe. When this pressure is reached, timing shall commence with a stop watch.

5. Determine the time, as shown on the stop watch, required for the pressure in the sealed line to drop 1.0 psig.

F. Test Method ASTM F1417-Plastic Gravity Sewer Line:

1. Low pressure air test method shall be the Time-Pressure Drop Method.

2. The pressure used in the test shall be the stated pressure plus the average back pressure of any groundwater above the pipe.

3. The time required for the pressure in the test section to drop 1.0 psig shall be measured using a stop watch. If the time is less than the time determined from ASTM F1417, the section fails. The table below has been reprinted from ASTM F1417 for Contractor's information.

Pipe Diameter, Inches	Minimum Time, Min.: Sec.	Length for Minimum Time, Feet	Time for Longer Length, Sec. (L=Ft)
6	5:40	398	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L

Pipe Diameter, Inches	Minimum Time, Min.: Sec.	Length for Minimum Time, Feet	Time for Longer Length, Sec. (L=Ft)
21	19:50	114	10.470L
24	22:40	99	13.674L

Note: Minimum time applied to all lengths less than or equal to the length shown. For more information, see ASTM F-1417, Table 1.

G. Air Pressure Adjustment for Groundwater:

1. In areas where groundwater is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple, approximately, 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, the groundwater level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube.

2. The air pressure correction, for the groundwater pressure above the pipe, shall be calculated as follows: Subtract the average invert elevation from the measured groundwater elevation. Multiply the elevation difference by 0.433 psi/feet to compute the pressure difference. Add the pressure difference to the test pressures stated in the test procedure.

PART 4 SPECIAL PROVISIONS

4.01 PIPE SCHEDULE

A. The following letter designations are used in the Piping Schedule:

Material Designation:
PVC - Polyvinyl Chloride
HDPE - High Density Polyethylene

B. Storm Sewer Schedule

Size	Thickness Class	Material	Spec Section	Remarks
12''	ASTM F2648	HDPE	02550	
30''	ASTM F2648	HDPE	02550	

C. Schedules are not guaranteed to be complete. All piping shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION

SECTION 02552
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing precast concrete manholes, including drops and manhole stacks of types and at locations shown on the Drawings and scheduled.

B. This Section includes removing existing structures, additional excavation to widen and deepen trenches for manhole construction, furnishing and installing concrete of classes called for, portland cement mortar, reinforcing steel, precast concrete pipe integral base sections, bottom riser sections, transition sections, and riser sections, eccentric cones, flat slab tops and grade rings, flexible manhole connections, pipe for drop connections, manhole steps, manhole frames and covers, plugging lifting holes, pointing joints, joint wrap installing, forming channels through manhole bottoms, making watertight connections to new and existing sewers, and other work incidental to manhole construction and testing.

C. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop drawings for Review:

   a. Manufacturer's Shop Drawings indicating physical dimensions, pipe openings, precast section arrangement, adjusting rings, castings, and joint details for each size and type of manhole components furnished for the project. Shop Drawing shall incorporate the planned elevations and details.

   b. Manufacturer's certification indicating that the manhole components and joints meet specifications for each production run for each size and type furnished.

2. Information for the Record:

   a. The Engineer may request test results to verify certification. Certification documents shall be according to the Source Quality Control of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Type of Manhole Sections:

1. Manhole Stacks - Manhole stacks shall mean 4-feet diameter manholes used for access to reinforced concrete manhole chambers and precast manhole riser tee sections.

2. Type I Manholes - Type I manholes shall mean 4-feet diameter manholes with precast integral base sections for sanitary sewers and either precast integral base sections or precast bottoms for storm sewers. Pipe connections to manholes shall be made with flexible watertight joints. Type I manholes are intended for installation of pipes 18-inch diameter and smaller unless noted otherwise.

3. Type II Manholes - Type II manholes shall mean manholes with 5-feet diameter precast integral base sections. Pipe connections to manholes shall be made with flexible watertight joints. Type II manholes are intended for installation of 21-inch through 30-inch diameter pipes unless noted otherwise.

4. Type IV Manholes - Type IV manholes shall mean manholes with cut-outs in the bottom riser sections installed on cast-in-place or precast concrete bases. The diameter of the bottom riser sections shall be as shown on the Drawings. Pipe connections above bottom riser section shall be made with flexible watertight joints. Type IV manholes are intended for installation on sewers 48-inch diameter and larger and on existing pipes where identified on Drawings.

B. Precast concrete pipe manhole sections, integral base sections, transition sections, eccentric cones, flat slab tops, and adjusting rings shall conform to ASTM C 478. Reinforcing in transition sections shall be equal to that specified for wall sections of the larger diameter.

C. Joints shall be tongue and groove type with a gasketed seal type conforming to ASTM C443.

D. The standard length of riser sections shall be 48-inch. Lengths of 32-inch or 16-inch shall be used to meet required dimensions and as specified.

E. Openings for connecting pipes in riser sections, bottom riser sections, and integral base sections, and for access in flat slabs shall be pre-formed or cored by the manufacturer, except “cut-out” openings may be made in bottom riser sections for Type IV manholes. Cut-out openings shall be made immediately after the pipe is removed from the casting form. All cored openings for sewer pipe connections shall have flexible joints.

F. Precast integral base sections shall be of monolithic construction. Base flat slab floors or integral floors shall have a minimum thickness of 6-inch for risers up to and including 48-inch in diameter and 8-inch for larger diameters. A layer of reinforcement shall be

placed above the midpoint and shall have a minimum area of 0.12 square inch/linear feet in both directions.

G. Manhole sections shall be constructed with no pipe connection within 6 inches of a joint in the structure.

H. Manhole sections shall be clearly marked and identified with the manhole number, section placement order, casting date, trademark, name of the manufacturer, and location of the production plant.

2.02 ACCESSORIES

A. Manhole Steps - Manhole steps shall be of polypropylene plastic reinforced with a 1/2-inch No. 60 grade reinforcing rod. Steps shall be M. A. Industries Model PS-1, or equal.

1. Specified manhole steps shall be factory installed to provide a continuous ladder of 16-inch Center-to-Center rung spacing. Steps shall be placed in the forms and cast in pipe wall or placed immediately after the pipe is removed from casting and carefully mortared in place with non-shrinking mortar to ensure a watertight joint. Manhole step installation shall be in compliance with OSHA regulations. If the outer surface of the pipe wall is pierced the patch shall be completely covered with a bituminous sealer.

B. Manhole frames and covers shall be as shown on the Drawings and in conformance with requirements of Section 05540.

1. Where pressure tight manhole frames and covers are called for, threaded inserts shall be cast in eccentric cones or flat slab tops and holes formed or cored in adjusting rings to match bolt size and spacing specified for manhole casting.

C. Mortar:

1. Mortar used for the structures herein specified shall conform to ASTM C270 Type S, containing no masonry cement. The mortar shall be composed of one-part portland cement to two parts sand by volume.

2. Non-shrinking Mortar - Materials for non-shrinking mortar shall be Sauereisen F-100, Five-Star, or equal.

D. Cast-in-Place Concrete:

1. All cast-in-place concrete used for concrete bases and for forming channels in manhole bottoms shall be Class A-2 as specified in Section 03300.

2. All concrete used for supporting precast concrete manhole bases shall be Class B as specified in Section 03300.

E. Reinforcing Steel - Reinforcing steel used in cast-in-place concrete shall meet the requirements of Section 03200.

F. Flexible Joints - Joints for precast pipe openings shall be “A-LOK X-CEL” as manufactured by A-LOK Products, Inc., “Kor-n-seal” as manufactured by National Pollution Control Systems, Inc., or equal in accordance with ASTM C923.

G. Pipe for Manhole Drops - Pipe for manhole drops shall conform to specifications of Section 02550 or Section 15210 for the required size and type shown on the Drawings.

H. Joint Wrap - Polyolefin backed exterior joint wrap used to cover the exterior side of joints shall be ConSeal CS212; Riser Wrap by Pipeline Seal & Insulator, Inc. or equal. Minimum width shall be 12 inches. Joint wrap shall include the use of brush or roller applied adhesive surface primer formulated for use with joint wrap. Seal shall meet the requirements of ASTM E1745, C-877, and ASTM C990.

I. Chimney seal shall be applied to the exterior of all manholes and shall cover the joint at iron casting, adjusting ring and lap over manhole riser/top section. Seal shall be HDPE heat shrink as manufactured by Pipeline Seal & Insulator, Inc. (Riser-Wrap) and CCI Pipeline System (Wrapid Seal), or equal.

J. Chimney seals which are installed on the interior of manholes will not be acceptable.

PART 3 EXECUTION

3.01 COORDINATION

A. Location and type of manholes installed shall be as shown on the Drawings or directed.

B. Construction shall be in conformance with details shown on the Drawings and as specified.

C. Excavation for manhole construction shall be prepared as directed in applicable paragraphs of Section 02200.

3.02 INSTALLATION OF INTEGRAL BASE SECTIONS

A. The manhole base may be placed on 6 inches compacted granular bedding material.

3.03 INSTALLATION OF BOTTOM RISER SECTIONS (WITHOUT INTEGRAL BASE)

A. Unless otherwise called for on the Drawings or directed, precast bottom riser sections shall be placed with cast-in-place reinforced concrete bases.

B. The base shall be of Class A concrete 12-inch thick minimum placed on undisturbed earth or a minimum 6-inch-thick aggregate stone cushion. Reinforcing shall be as shown on the Drawings.

C. The cut-out riser section shall be blocked in place above the pipe and the concrete base poured in place. Concrete shall be extended above the lower rim of the riser wall as required to provide a watertight seal around the entire circumference of the riser section. The sewer pipe shall be bedded in concrete monolithic with the base to the first joint each way from the manholes.

D. On straight runs the Contractor may carry the pipe through the manhole and break out the top half after the fill concrete has set. In all cases the pipe shall extend through the manhole wall to the inside face.

3.04 CHANNELING MANHOLE BOTTOMS

A. The bottoms of all manholes shall be channeled to conduct flow in the planned direction. The channel walls shall be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance of flow in the sewers and shall match inverts of connection pipe at the manhole wall.

B. Manholes which do not have integral base or channels precast with base section, as approved by Engineer, shall have channels formed and placed in the field with Class A concrete.

3.05 PRECAST CONCRETE RISER SECTIONS

A. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the eccentric cone section or the flat slab top.

B. Riser section joints shall be pointed and lifting holes filled with non-shrinking mortar.

C. Riser section exterior joints shall be wrapped and sealed with joint wrap as specified herein. Concrete shall be primed a minimum of two times. The first coat shall be allowed to fill concrete depressions and bug holes. Contractor shall follow manufacturer recommendations.

D. Contractor shall protect joint wrap from damage during back filling and other related work.

3.06 INSTALLATION OF MANHOLE FRAMES

A. Manhole frames and covers shall be installed to grades shown on the Drawings or as directed.

B. Adjustment of manhole castings shall be made using specified precast grade rings and portland cement mortar joints or preferred bitumen seals.

C. Each manhole casting shall be anchored in place using four 5/8-inch stainless steel bolts with nuts as detailed on the Drawings or directed.

D. The maximum depth of adjustment below any manhole casting shall be 16 inches and the minimum depth of adjustment shall be 4 inches.

E. In concrete pavement, separate frame from pavement with 1/2-inch thick premolded mastic joint material extending from the base of the frame to the top of the frame.

F. Manhole castings located in pavement areas shall be installed with the top of the casting 1/4 inch below the finished grade of the adjacent pavement surface.

3.07 CHIMNEY SEAL

A. Installation of chimney seal shall be after casting has been adjusted to final grade. Chimney seal shall cover all joints at manhole top including, but not limited to, iron casting, adjusting rings and manhole riser.

B. Chimney seal shall be installed per manufacturer recommendations. Chimney seal shall provide a water tight seal.

3.08 MANHOLE TESTING

A. Each manhole shall be tested in accordance with ASTM C1244 'Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.' in the presence of the Engineer

B. All lift holes shall be plugged with an approved non-shrink grout before testing.

C. All pipes entering the manhole shall be plugged and braced to prevent being drawn into the manhole.

D. Testing shall be by drawing a vacuum on the manhole using equipment specifically designed for such testing. A test head with necessary gauges and connections shall be placed at the inside of the top of the cone section and sealed in accordance with the manufacturer's instructions. A vacuum of 10 inches of mercury shall then be drawn and the vacuum pump shut off. With valves closed, the time shall be measured for the vacuum to drop to 9 inches. The test shall be successful if the time measured is greater than the required time based on the following chart:

	Diameter (in)				
	48	**60**	**72**	**84**	**96**
Depth (ft.)	**Time (sec.)**				
<4	10	13	16	20	23
6	15	20	25	29	34
8	20	26	33	39	45
10	25	33	41	48	56
12	30	39	49	58	67
14	35	46	57	67	78
16	40	52	67	77	89
18	45	59	73	86	100
20	50	65	81	96	111
22	55	72	89	105	122
24	59	78	97	115	133
26	64	85	105	124	144
28	69	91	113	134	155
30	74	98	121	143	166

E. If the test is unsuccessful, necessary repairs shall be made and retesting shall proceed until a satisfactory test is obtained.

F. If a manhole is constructed of different diameters, the largest diameter shall be used to determine the time required for testing.

G. The Contractor may perform testing after completely backfilling the manhole, and the following modification to the testing procedure shall be followed.

1. Determine depth of water table and depth of manhole being tested.

2. Using above depths, calculate the hydrostatic head above the lowest manhole connection.

3. Adjust test pressure according to the following table:

Hydrostatic Head (ft)	≤12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	0

4. If hydrostatic head above the lowest manhole connection is equal to or greater than 22 feet, vacuum testing must be completed before backfilling.

PART 4 SPECIAL PROVISIONS

4.01 BIOFILTER BUILDING SUMP

A. Sump pumps shall be provided by others but the sump shall be provided per this contract.

B. Sump shall be 8 feet diameter, 10 feet deep concrete manhole with hatch top flush with the concrete foundation floor.

END OF SECTION

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SECTION 02554
CATCH BASINS AND INLETS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing precast, cast-in-place, and masonry inlets and catch basins of designated types and at locations shown on the Drawings and scheduled.

B. This Section includes all necessary excavation, removing existing structures, furnishing and installing concrete of classes called for, reinforcing steel, brick, precast solid concrete block, portland cement mortar, precast concrete inlet structures, flexible joints where specified, inlet castings, making watertight connections to new and existing sewers, and other incidental work.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for review:

a. Manufacturer's certification indicating the manhole components and joints, for each production run for each size and type furnished meet specifications.

b. General assembly drawings, identifying catch basin and inlet components, physical dimensions and compliance with Specifications.

PART 2 PRODUCTS

2.01 TYPES OF CATCH BASINS AND INLETS

A. Types of inlets and catch basins included under this Section shall be as designed and detailed on the Drawings or as specified by reference to City, State, or County standards or modifications thereof.

B. The terms catch basins and inlets as used herein refer to nomenclature of standard drawings for specified structures and of details shown on the Drawings.

2.02 MATERIALS

A. Precast Solid Concrete Block - Precast solid concrete block shall conform to ASTM C139.

B. Mortar - Mortar used for the structures herein specified shall conform to ASTM C-70 Type S containing no masonry cement. The mortar shall be composed of one-part portland cement to two parts sand by volume.

C. Precast concrete inlet structures shall conform to ASTM C913.

D. Cast-in-place concrete shall comply with requirements of Section 03300.

E. All joints in the walls and bottom of precast catch basins and inlets shall be tongue and groove type with a preformed butyl rubber joint sealant placed in the joint prior to assembly of the joint. This joint material shall provide a permanent flexible non-shrinking watertight seal and shall meet the requirements of ASTM C990. After assembly of the joint, a 12-inch-wide band of permanent flexible water barrier wrap shall be applied to the exterior surfaces centered on all wall joints and any buried top slab joints. This barrier wrap shall meet the requirements of ASTM E1745, C877, and C990. The barrier wrap shall be bonded to the concrete with a brush or roller applied adhesive surface primer formulated for use with the barrier wrap material.

2.03 ACCESSORIES

A. Flexible Joints - Joints for precast pipe openings shall be “A-LOK X-CEL” as manufactured by A-LOK Products, Inc., “Kor-n-seal” as manufactured by National Pollution Control Systems, Inc., or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Location and type of inlets and catch basins installed shall be as shown on the Drawings, scheduled, and specified herein.

B. Detailed drawings of specified City or County catch basins and inlets will be furnished by the Owner. State Highway Standard Detail drawings must be obtained by the Contractor.

3.02 INSTALLATION

A. Installation shall be in conformance with relevant portions of the following:

1. Section 02200.
2. Section 02552.
3. Details shown on the Drawings.
4. Specified standards.

B. Brick, concrete block, etc., having a temperature of 40 degrees F or less shall not be set with mortar until heated for a sufficient period to insure a temperature of at least 50 degrees F throughout the entire mass of the material.

C. The construction of these structures shall be done in strict conformance with the details shown on the Drawings or the applicable State, City, or County Detail Drawing, as specified.

D. Unless otherwise noted on the Drawings, catch basin leads shall be placed at 1.00% grade.

PART 4 SPECIAL PROVISIONS

4.01 EXISTING CATCH BASINS TO REMAIN

A. In locations where new sewer or catch basin lead has been installed to connect an existing catch basin or manhole, the connection shall be done by either of the following methods:

1. A flexible connection as specified in Section 02552 and shown on the Drawings.

2. Concrete Encasement - Concrete encasement, 6-inch minimum shall be carried to the first pipe joint.

END OF SECTION

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SECTION 02561
PRECAST CONCRETE BOX CULVERTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing of precast concrete box culverts, of types and sizes as shown on the Drawings and specified.

B. This Section includes removing any existing structures, excavation as needed for culvert construction, bedding materials, furnishing and installing concrete of classes called for, portland cement mortar, reinforcing steel, plugging lifting holes, pointing joints, forming channels through culvert bottoms, making watertight connections to new and existing sewers, and other work incidental to culvert construction and testing.

C. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. Manufacturer's literature indicating physical dimensions, components, details, and joint details for each size and type of box section components.

   b. Laying Schedule

2. Information for the Record:

   a. Manufacturer's certification indicating that the box section components and joints meet specifications for each production run for each size and type furnished.

   b. The Engineer may request test results to verify certification. Certification documents shall be according to the Source Quality Control of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Precast concrete box sections shall be designed and certified by a licensed engineer in the state of the project for the conditions shown on the Drawings and specified or as required.

B. Precast concrete box sections shall be designed as a minimum to ASTM C1433 Table 1 as conditions require unless otherwise specified in Part 4.

C. Precast concrete box sections shall be reinforced air entrained concrete with formed interior and exterior surfaces. Sections shall be of manufacturer's standard size and configurations as may be applicable.

D. Sections shall have an integral base section.

E. Precast concrete box sections shall conform to ASTM C1433.

1. All box sections shall be marked with the date of manufacture, span, rise, maximum and minimum design earth cover, and applicable ASTM C1433 Table number. The top of all structures shall be clearly marked with the word "top".

F. Joints shall be tongue and groove type with a preformed flexible joint sealant conforming to ASTM C990. All exterior joints shall be wrapped with joint wrap conforming to ASTM C877.

G. Sections shall comply with Federal, State and Local requirements of those having jurisdiction on drainage.

2.02 ACCESSORIES

A. Joint Wrap:

1. Joint wrap used to cover the exterior side of joints shall be ConSeal CS-212, or equal.

2. Joint Wrap Primer shall be per manufacturer's recommendations.

B. Mortar:

1. Non-shrink Nonmetallic Grout - Materials for non-shrink nonmetallic grout shall be Sauereisen F-100, Five-Star, or equal.

C. Granular Pipe Bedding Material:

1. Granular pipe bedding material shall be as specified in Section 02200.

PART 3 EXECUTION

3.01 COORDINATION

A. Construction in highway right-of-way shall conform to the requirements of Section 02200.

3.02 PREPARATION OF TRENCH

A. Trench excavation shall conform to requirements of Section 02200.

B. For box culverts the width of trench shall be the outside width of the culvert section plus 2 feet minimum on either side of the culvert.

C. Culvert sections shall be placed on 6-inch minimum pipe bedding material.

3.03 BOX CULVERT INSTALLATION

A. All loose dirt shall be removed from the bottom of the trench and the trench backfilled with specified bedding material to pipe laying grade, as detailed on the Drawings. The box section shall be placed and supported on bedding material the full length of the section. Additional bedding material shall then be placed and compacted in 6-inch layers to the height shown on the Drawings or as directed. Hand tampers shall be used for installing backfill material until 2 feet of cover is placed over the culvert. The remainder of the trench shall be backfilled as specified, shown on the Drawings, or as directed.

B. Backfill compaction shall conform to the requirements of Section 02200.

C. The laying of box sections in finished trenches shall be commenced at the lowest point, with the groove end laid upgrade. All box sections shall be laid with ends abutting and true to line and grade. They shall be carefully centered to form a sewer with a uniform invert of line and grade as shown on the Drawings or as directed.

D. All box sections shall be laid to lines and grades by use of a laser beam and checked in conformance with Section 01800. Sections installed more than 0.04 feet above or below specified elevation shall be removed and reinstalled to grade.

E. Where holes are cast in box sections for handling, they shall be completely filled with non-shrink nonmetallic grout after the section is placed. A metal disc of proper size may be inserted near the bottom of the hole to retain the grout until hardened. Wood plugs or rocks intended to plug the hole for retention of the grout will not be permitted.

3.04 JOINTS

A. Preformed flexible joint sealant shall be placed between the bell and spigot of every joint.

B. Prior to backfilling the exterior side of all joints shall be wrapped with a joint wrap installed per manufacturer’s instructions.

C. Non-Shrink Nonmetallic Grout Joints - Where specified or shown on the Drawings, joints of concrete culverts shall be thoroughly pointed full inside circumference with a non-shrink nonmetallic grout in conformance with the material manufacturer’s instructions. The grout shall be tightly packed and the interior face of the joint shall be left smooth and continuous with the interior face of the culvert. Pointing shall not be done until the backfill over the culvert is placed and compacted.

3.05 FIELD CUTTING

A. All field cutting shall be done with a saw large enough to cut the full wall thickness of the box section.

B. Holes for pipe penetrations shall be core drilled.

3.06 FIELD QUALITY CONTROL

A. Field Inspection:

1. Individual box sections may be rejected at any time because of defective joints, dimension variations, fractures, cracks, honeycombing, chips, or blisters exceeding the permissible tolerances.
2. Rejected box sections shall be so marked with a lumber crayon or paint and shall be removed from the job site before the end of the following work day.

B. Correction of honeycombing, chips, blisters and filling lifting holes shall not be allowed without prior approval from engineer.

PART 4 SPECIAL PROVISIONS

4.01 DESIGN LOADS

A. The design dead and live loads are as follows:

1. Earth dead load plus AASHTO HS20 live load (ASTM C1433 Table 1).

4.02 XYPEX ADDITIVE

A. Contractor to provide antimicrobial protection and crystalline waterproofing additive to precast concrete box culvert as specified herein.

B. Additive shall be Xypex Admix Bio-San C-500 or approved equal.

C. Concrete antimicrobial system shall contain bio-active mineral solids that become permanently fixed within the cement matrix to stop the growth of microbials.

D. Concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete. The system shall cause the concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.

E. The manufacture of the crystalline water proofing shall provide the type of material and the dosage rate for the application. Admix must be added to concrete mix at time of batching. The actual dosage in the mix design shall be certified at the time of application.

F. Manufacturer shall coordinate with the concrete batch facility and other admixture suppliers to ensure compatibility with the concrete mix design, other admixtures and concrete properties. The addition of the crystalline water proofing shall not reduce the concrete strength or compromise the ASTM specifications or other quality standards governing the concrete mix.

G. Concrete containing Xypex Admix shall be moist cured in accordance with ACI Reference 308, “Standard Practice for Curing Concrete”.

END OF SECTION

SECTION 02600
PAVEMENTS, CURBING AND WALKS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the construction of sidewalks, curbing pavements, and berms of various designated types as shown or scheduled on the Drawings, specified or directed.

B. This Section includes preparation of the base and subgrade construction of walks, curbs, pavements and base courses, adjustment of manhole castings, and valve boxes to conform to new pavement courses, and other work and materials incidental to the construction of pavements, curbing and walks.

C. Existing curbs and walks of stone or concrete shall be replaced using concrete.

D. This Section includes temporary and restoration of permanent pavement markings as they exist at the time of bidding unless otherwise shown on the Drawings, specified or directed.

1.02 OWNER'S STANDARDS AND SPECIFICATIONS

A. Sidewalks, curbs, driveways, parking areas, and street pavement and berms disturbed by construction shall be restored in accordance with the Owner's present standards and specifications.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. Manufacturers' and suppliers' material certificates.

   b. A sieve analysis (ASTM C136) shall be furnished for each material source.

2. Information for the Record:

   a. Delivery tickets from the asphalt and aggregate suppliers shall be given to the inspector at the unloading site. Tickets shall include (as a minimum) name of source, date, type of material, and weight.

   b. Test results and certificates.

PART 2 PRODUCTS

2.01 AGGREGATE BASE AND SURFACE

A. The aggregate shall be crushed limestone meeting the requirements of MDOT Table 902-1, Class 21AA or 22A.

2.02 RESERVED

2.03 ASPHALT EMULSIONS

A. The bond coat material shall be SS-1h or CSS-1h, and shall meet the requirements of MDOT Table 904-4 and 904-5.

B. The prime coat material, if required, shall be MS-Op and shall meet the requirements of MDOT Table 903-4.

2.04 BITUMINOUS AGGREGATE BASE AND ASPHALT CONCRETE

A. Bituminous Material - The asphalt cement shall be PG 58-28 performance grade (Design Temperature) and shall meet the requirements of MDOT Table 904-2.

B. Design Mix - Refer to MDOT Section 501.

1. The base course shall meet the requirements of MDOT Mixture No. 2.
2. The leveling course shall meet the requirements of MDOT Mixture No. 3.
3. The wearing course shall meet the requirements of MDOT Mixture No. 5.

2.05 CONCRETE (CAST-IN-PLACE)

A. All concrete used shall be Class “A” as specified in Section 03300.

B. Concrete reinforcement shall be in accordance with Section 03200.

C. Other materials required for placing concrete shall be as follows:

1. Joint Sealer:
    a. Hot Applied Sealer - MDOT Section 914.04A.
    b. Backer Rod - MDOT Section 914.04B.
2. Preformed Fiber Joint Filler - MDOT Section 914.03.
3. Curing Materials:
    a. Burlap Cloth - AASHTO M182, Class 2.
    b. Sheet Materials - ASTM C171.
    c. White Membrane Curing Compound - ASTM C309, Type 2, Class B.

d. Transparent Membrane Curing Compound - ASTM C309, Type 1, Class B.

2.06 PAVEMENT MARKING

A. Contractor shall provide temporary and permanent pavement markings equal to those markings that are removed from existing paved surfaces prior to commencement of the Work unless scheduled on the drawings, specified, or as directed. See Ohio edit

B. Pavement markings shall be in accordance with the requirements of MDOT Item 811.

C. Pavement markings shall match existing or adjoining pavement markings.

D. Pavement markings partially disturbed by construction shall be replaced entirely.

PART 3 EXECUTION

3.01 COORDINATION

A. All soil subgrade under pavements, driveways, curbs, curb and gutter, and walks shall be compacted in accordance with Section 02200.

B. All service boxes, manholes, inlets and other structures shall be adjusted or reconstructed to the required grades in both new and resurfacing pavement areas.

3.02 PAVEMENT INSTALLATION

A. All construction shall be in conformance with applicable portions of MDOT Specifications, except as otherwise specified or called for herein.

B. Unless otherwise directed by Engineer all aggregate bases which are to receive bituminous courses shall be primed as specified.

C. A tack coat at a rate as specified shall be applied to all existing pavements which are to be overlaid, and between subsequent courses when directed by the Engineer.

3.03 TRANSITION JOINTS FOR BITUMINOUS CONCRETE PAVEMENT OVERLAY

A. Types of Transition Joints:

1. Transition joints shall be either butt type or feathered type as directed by the Engineer.

2. Butt joints shall be used on State and Federal roads and main thoroughfares and feathered joints used elsewhere unless otherwise specified.

3. Butt Joints:

a. When a butt joint is called for on the Drawings or specified, the old surface shall be cut back for at least 3 feet to a depth of at least 1 inch for the full width of the joint and pavement installed.

b. A bituminous seal shall be placed on the finished surface at the junction of the new and old pavements.

4. Feathered Joint:

a. Feathered joints shall be constructed by manually raking the paving material to a smooth transition from the full depth material to the existing pavement surface.

b. Existing pavement surface shall be bond-coated to include the transition area.

c. Feathering shall be done by a workman skilled in the operation and shall be approved by the Resident Project Representative.

3.04 CURBING

A. Curbing shall be constructed in conformance with applicable portions of MDOT section 802 and the MDOT Standard Construction Drawings.

B. Place 1-inch dowelled expansion joints at inlets and at spring lines of street and driveway returns. If intersecting streets and driveways are more than 300-feet apart, place expansion joints at 300-feet intervals.

C. Contraction joints shall be placed at approximately 10-feet intervals.

3.05 RESERVED

3.06 CONCRETE DRIVEWAYS

A. Concrete driveways shall be constructed in conformance with applicable portions of MDOT Section 801.

B. Dowelled contraction joints shall be placed at a maximum spacing of 20-feet. Lesser spacing shall be used on irregular areas as directed by the Engineer.

C. Expansion joint filler 1/2-inch thick shall be installed at intervals of 24-feet maximum. One-inch expansion joint filler shall be installed between the driveway and any fixed structure.

3.07 BITUMINOUS AND AGGREGATE DRIVEWAYS

A. Bituminous driveways and parking lots shall be constructed as shown on the Drawings and indicated in Part 4 using materials specified for asphalt concrete pavements. Placement shall be in accordance with MDOT Section 501.

B. Aggregate driveways and parking lots shall be constructed as shown on the Drawings using base aggregate meeting the requirement of MDOT Item 302.

C. Replacement of bituminous or aggregate driveways and parking lots shall conform to Section 01565 and this Section but in no case, be inferior to that being replaced.

3.08 RESERVED

3.09 INSPECTION

A. Laboratory services shall be in accordance with the requirements of the IFB and Section 01410 and shall include:

1. A compaction test on the subgrade, aggregate base, and each layer of asphalt shall be performed for every 300 square yards of material placed.

2. Asphalt Concrete:

a. Plant Certification - The laboratory shall certify or furnish recent certification (within one year) that the plant meets State requirements.

b. Plant Inspection - For the first day of production and for every day when more than 100 cubic yards of material is being delivered to the project, the laboratory shall provide a representative at the plant who will inspect the plant, make mix design adjustments, check the temperature, and take the required samples.

c. Quality Control Testing - A sample of the mix shall be taken for each 200-cubic yard of bituminous material or fraction thereof delivered to the project. An extraction test AASHTO T164-70 and a mechanical analysis AASHTO T30-70 shall be performed on the mix samples.

d. Bituminous Material - Provide a satisfactory certificate furnished by the manufacturer stating that the materials conform to MDOT Specifications, Table 904-2, 904-3, or 904-4 as required.

e. Aggregate - A sieve analysis (ASTM C136) shall be performed on each aggregate to be used in the plant mix design.

f. Mix Designs - The supplier shall design the plant mixes in accordance with the Marshall Method of Mix Design (ASTM D1559) and shall make all mix design adjustments.

d.

3. Cast-in-Place Concrete:

a. Concrete shall be tested in accordance with Section 03300, Cast-in-Place Concrete.

3.10 PROTECTION

A. No heavy construction vehicle shall operate on any pavement, curbing or walk after it has been installed.

B. Traffic shall be prohibited on newly installed asphalt pavement until it has cooled sufficiently to avoid marking.

C. Asphalt Pavements:

1. Bituminous mixtures shall be transported and placed in accordance with MDOT Section 501.03.

D. Concrete Pavements, Curbing and Walks:

1. Concrete shall be mixed, transported, placed, and finished only within the temperature limitations specified in MDOT Sections 601.03F and 602.03T.

2. No concrete shall be mixed, transported, placed, or finished when the temperature of the base, subgrade, or air is below 40 degrees F or whenever, in the opinion of the Engineer, the temperature may fall below 40 degrees F within 24 hours after the concrete has been placed.

3. The Contractor shall take such precautions as are necessary to protect the concrete from rain.

4. The Contractor shall protect the concrete from freezing for no less than seven days or until such time that specimen beams have attained a modulus of rupture of at least 600 psi.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 02710
FENCING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all materials, equipment, labor, and supervision necessary for the installation of new fencing as shown on the Drawings and to replace fencing damaged during construction in accordance with the Contract Documents.

B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturers' recommendations.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's product literature.

b. Materials of Construction.

1.03 PROJECT HANDLING

A. Materials, including but not limited to post, barb wire, and fence fabric, shall be handled and stored in accordance with the manufacturer's recommendations and in such a manner as to prevent any damage to the finish coating.

PART 2 PRODUCTS

2.01 FENCE FABRIC

A. Fence fabric mesh, gauge, tension wires, tie wire, and coatings shall match the existing in material, size, coatings, and color.

2.02 FENCE POST AND RAILS

A. Line posts, rails, tension wire, posts, ends, and corners shall all match the existing in material, size, height, coatings, spacing, and color.

2.03 RESERVED

2.04 ACCESSORIES

A. Barbed wire shall match the existing.

PART 3 EXECUTION

3.01 COORDINATION

A. Permanent fencing may be installed for convenience of the Contractor prior to completion of Work.

1. Contractor shall be responsible for maintenance and repairs to keep the fence system like new during construction. The fencing system is subject to the Owner and Engineers approval at project completion and the entire system or any part there off may be required to be replaced.

3.02 PREPARATION

A. Final grading shall be completed prior to the installation of the permanent fence system.

3.03 INSTALLATION

A. The Contractor shall erect the fence, gates, and fence posts level and plumb as required, in accordance with manufacturer's recommendations and as shown on the Drawings.

B. Line posts shall be spaced at intervals not exceeding 10-feet.

C. Fence fabric shall be stretched taut, securely fastened to the posts, tension wire and top rail as specified and shown on the Drawings.

1. Fence fabric shall be installed approximately 1 inch above the top rail.

2. Fence fabric shall be installed approximately 2 inches above finish grade. Fence fabric when lifted shall not allow an opening greater than 5 inches.

3. Fence fabric shall be stretched at a maximum of 30 feet and all terminal posts.

D. All changes in fence alignment of 30 degree or more and all abrupt changes in grade shall be made with corner posts.

E. Foundations for post shall be sized by fence manufacturer.

1. Foundations shall extend a minimum of 36 inches below finish grade.

2. Concrete foundation shall have a minimum outside diameter of 3 times the embedded post OD and not less than 9 inches.

3. Concrete foundation shall be crowned to shed water way from the embedded post.

4. Concrete foundation shall be belled at the bottom.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 02800
SODDING, SEEDING AND MULCHING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes fine grading, placing sod, and seeding and mulching areas designated on the Drawings, specified, or ordered.

B. The Work consists of fine grading, furnishing and placing topsoil; sod; seed; mulching material; and fertilizer; and watering seeded or sodded areas until growth is established.

C. The Contractor shall restore all grass areas damaged by his operations.

D. Unless otherwise specified herein or directed, Work shall be in conformance with MDOT Section 816, Turf Establishment.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's project information for materials.

2. Information for the Record:

a. Submit to Resident Project Representative:

1) Invoices indicating the weight, brand, and composite analysis of fertilizer used on the project.

2) Bag tickets indicating weight and composition of all seed used on the project.

PART 2 PRODUCTS

2.01 SOD

A. Sod shall conform to MDOT 917.13, unless otherwise specified in Part 4.

2.02 SEED

A. Seed mixtures shall be in conformance with the requirements of MDOT Tables 816-1 and 917-1, Mixture TUF, unless otherwise specified in Part 4.

2.03 FERTILIZER

A. Commercial fertilizers shall be from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Michigan, Department of Agriculture. The content of nutrients shall be 12-12-12, unless otherwise approved by Engineer.

2.04 MULCHING MATERIAL

A. Mulching material shall be straw, wood fiber or compost reasonably free of weed seed, and other foreign materials, conforming to MDOT Section 917.15A.

2.05 MATTING MATERIAL

A. Matting material shall be in conformance with the requirements of MDOT Section 917.14B, unless otherwise specified in the Special Provisions.

2.06 TOPSOIL

A. Topsoil furnished by the Contractor shall be as specified in Section 02200.

PART 3 EXECUTION

3.01 FURNISHING AND PLACING TOPSOIL

A. Areas from which the top layer of soil has been removed or disturbed shall be recovered with a minimum of 4 inches of recompacted topsoil placed in conformance with Section 02200 or MDOT Section 816.03A.

3.02 PREPARATION

A. The operating of finish grading and sowing shall not be performed when the ground is frozen or muddy.

B. Areas to be Sodded:

1. Preparation of areas to be sodded shall be in conformance with MDOT Section 816.03D.

C. Areas to be Seeded:

1. Unless otherwise shown on the Drawings or specified in Part 4, all areas of disturbed soil on the Site shall be seeded.

2. The area to be seeded shall be prepared in accordance with Section 02200.

3. Fertilizer shall be applied at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients in equal proportions of Nitrogen, Phosphoric Acid, and Potash. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed, or raked into the soil to a depth of not less than 1 inch.

3.03 INSTALLATION

A. Sodding:

1. Sod shall be placed in conformance with MDOT Section 816.03D.

2. No sod shall be placed when the temperature is below 32 degrees F. No frozen sod shall be placed nor shall any sod be placed upon frozen soil. When sod is placed between the dates of June 1 and October 15, it shall be covered immediately with a straw mulch 1-inch-thick, loose measurement.

B. Seeding:

1. The seed shall be mixed thoroughly and sown evenly at a rate specified by MDOT. The seed mixture may be sown dry or hydraulically unless directed otherwise in Part 4 of this Section.

2. The seed mixture shall be applied when the soil is in a workable condition and shall be raked into a depth of approximately 1/4 inch.

3. Seed shall be sown only between the dates of May 1 and October 15, unless otherwise permitted by the Engineer.

C. Mulching:

1. Within 24 hours after an area has been seeded it shall be mulched in conformance with one of the following specified methods as designated in Part 4:

2. Mulch:

a. Mulching with hay or straw shall be in conformance with mulching requirements of MDOT Sections 816.03E, F, and G except that in front of residences the mulching material shall be kept in place by an approved non-tracking adhesive or other approved method in lieu of the specified asphalt emulsion.

b. Matting shall be used on all slopes greater than 10:1. Matting used for mulching shall be placed in conformance with MDOT Section 816.03H.

D. Seeded and sodded areas shall be watered and maintained as specified below until they are established.

1. The seed bed shall be thoroughly watered, as soon as the seed is covered.

2. Water shall be applied by a hydro-seeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.

3. Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period.

4. The rate of application shall be 240 gallons per 1,000 square feet

5. The Contractor shall keep all sodded areas, including the subgrade, thoroughly moist for two weeks after sodding. After the two-week period, the Contractor shall water the sod as specified above.
6. Mulch and matting areas shall be maintained until all Work on the Contract has been completed and accepted.
7. The seeded area shall be mowed once at an approximate height of 6 inch as directed by the Engineer to control excess growth, including weeds.
8. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in these damaged seeded areas shall be restored to the condition and grade existing prior to application of mulch or matting, and restored areas shall be relimed, refertilized, and reseeded. Where necessary, the mulch or matting shall be completely replaced. Damaged sod shall be replaced with new sod.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 02810
TREES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes protection, removal, disposal, and replacement of trees encountered in construction of the Project as specified herein and directed.

B. Trees in easements shall be included in this Section, except as otherwise stated in the easement agreement.

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless specified otherwise in Part 4 or on the Drawings, trees shall be replaced with trees of the same species and varieties as removed.

B. Trees smaller than 4 inches in trunk diameter shall be replaced with trees of comparable size to those removed.

C. Trees 4 inches in trunk diameter and larger shall be replaced with trees of 4 inches minimum trunk diameter unless otherwise directed.

D. The Contractor may remove, preserve, and replant existing trees in lieu of installing replacement trees.

PART 3 EXECUTION

3.01 COORDINATION

A. The Resident Project Representative will designate, mark, and record the location, size, species, and variety of trees within the Work limits that must be protected or removed and replaced.

B. Where authorized by the Owner, the Contractor will not be required to replace designated trees removed for construction of the Project.

C. Trees designated for removal and replacement shall be removed, preserved, and replanted or replaced by the Contractor after construction is completed.

D. Any tree not included in the above damaged by the Contractor’s operations to the extent that it must be removed shall be removed and replaced at the Contractor’s expense.

3.02 INSTALLATION

A. Planting shall be in accordance with the applicable portions of MDOT Section 815.

3.03 PROTECTION

A. The cutting of roots or branches shall be held to a minimum.

B. Cables shall not be wrapped around trees nor shall trees be used for deadman purposes.

C. If necessary construction work will cause excessive damage to trees involved, the Contractor shall contact the Engineer before proceeding with the Work.

D. Should any of the replanted trees die after final acceptance of the Work, but during the one-year maintenance bond period, such trees shall be replaced in kind and size as nearly as possible by the Contractor at his expense.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes formwork for cast-in-place concrete.

1.02 SUBMITTALS

A. None required.

1.03 QUALITY ASSURANCE

A. Design, engineering, erection, bracing, and shoring of formwork shall be the responsibility of the Contractor.

B. Formwork shall comply with pertinent provisions of the following codes, standards, and specifications:

1. "Guide to Formwork for Concrete (ACI 347R)," American Concrete Institute.
2. "Standard Tolerances for Concrete Construction and Materials (ACI 117)," American Concrete Institute.
3. "Formwork for Concrete, SP-4". "American Concrete Institute."

C. Formwork shall be designed in accordance with requirements of governmental agencies having jurisdiction, pertinent requirements of local building codes, "Building Code Requirements for Structural Concrete (ACI 318) and Commentary (ACI 318R)," and "Specifications for Structural Concrete (ACI-301)," American Concrete Institute.

D. Formwork for liquid retaining structures shall also satisfy the requirements of "Environmental Engineering Concrete Structures (ACI-350)," American Concrete Institute.

E. Formwork shall be constructed to tolerances specified in ACI 117.

F. Regardless of specified tolerances, no portion of a structure shall extend beyond legal boundary of project.

PART 2 PRODUCTS

2.01 MATERIALS

A. Form facing material shall be "new or undamaged" condition and may be plyform, tempered concrete-form-grade hardboard, metal, plastic, or other material capable of producing the specified finish. Select the grade or class of material to satisfy the requirements of strength, stiffness and surface smoothness to produce the specified finish.

B. Form Release shall be manufactured from Dayton Superior “Clean Strip J1EF”, W.R. Meadows, Inc. “Duogard or Duogard II”, L&M Construction Chemicals “Debond Form Coating”, or equal.

C. Arrangement of facing material shall be orderly and symmetrical, with number of seams kept to practical minimum.

D. Facing material shall be supported by studs or other backing capable of preventing excessive deflection. Maximum deflection of facing material shall be 1/240 of span between supports but shall not exceed specified tolerances.

E. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects shall not be used.

F. Architectural Concrete: Maximum deflection of facing material between studs and deflection of studs and walls shall not exceed 1/400 of span between supports, but shall not exceed specified tolerances.

2.02 PERFORMANCE REQUIREMENTS

A. Formwork shall be designed to safely support vertical and lateral loads, until such loads can be safely supported by concrete structure. Loads shall be carried to ground by formwork and in-place construction of adequate strength.

B. Formwork shall be designed for dead and live loads, weight of concrete, wind, construction loads including impact, and other loads which act or might act on formwork together with appropriate safety factors and load multipliers as recommended by ACI-347.

C. Formwork shall be designed for pressure of concrete giving due consideration to rate of concrete placement, method of placement, method of consolidation, concrete mix design, temperature, and other factors pertinent to formwork design.

D. Forms shall have sufficient strength and rigidity to maintain specified tolerances.

PART 3 EXECUTION

3.01 COORDINATION

A. Forms shall be used to confine concrete and shape it to required dimensions, alignment, elevation, and position.

B. Earth cuts shall not be used as forms for vertical surfaces unless specifically shown on the Drawings.

C. Runways for moving equipment and materials shall be supported directly on formwork or structural member, and shall not rest on reinforcing steel.

D. Openings shall be provided in formwork to accommodate Work of other trades. Openings shall be accurately located and cut.

3.02 PREPARATION OF FORM SURFACE

A. Surfaces of forms and embedded materials shall be cleaned of accumulated concrete or mortar from previous concreting. Foreign material and contaminants shall be removed before concrete is placed.

B. Before placing reinforcement or concrete, surfaces of forms shall be covered with acceptable coating material that prevents bond with concrete, VOC compliant, and does not stain concrete surface. No coating material shall be used if form liner is used.

C. Form coating material shall not stand in puddles in forms, and shall not come in contact with reinforcement or hardened concrete against which fresh concrete is to be placed.

3.03 ERECTION

A. Forms shall be sufficiently tight to prevent loss of mortar from concrete.

B. Formwork shall be cambered to compensate for anticipated deflections from weight of fresh concrete and construction loads.

C. Shores and struts shall be provided with positive means of adjustment capable of taking-up formwork settlement during concrete placement, using wedges or jacks.

D. Formwork shall be securely braced and anchored against deflection and displacement.

E. Wedges used for final adjustment of formwork shall be fastened in position prior to beginning concrete placement.

F. Temporary openings shall be provided at base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.

G. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling of forms. Wood inserts for keyways, reglets, recesses and similar uses shall be kerfed to counteract swelling.

H. At construction joints, form facing material shall overlap hardened concrete of previous placement by not more than 1 inch. Forms shall be held tight against hardened concrete to prevent offsets or loss of mortar, and to maintain true surface.

I. Insert vibrator as needed to properly consolidate concrete. Provide openings in forms as needed to insert vibrators.

J. Form ties and accessories:

1. Form ties and accessories to be partially or wholly embedded in concrete shall be of commercially manufactured type. Nonfabricated wire is not permitted.

2. Form ties shall be constructed so that ends can be removed to minimum depth of 1-1/2 inch without significant spalling of concrete. Form tie assemblies shall provide cone-shaped depressions 1-1/2-inch-deep and at least 1 inch in diameter at concrete surface to permit filling and patching.

3. Ties shall be tight fitting or tie holes in forms shall be sealed to prevent leakage.

4. Single rod ties shall be furnished with tightly fitted washer at midpoint to prevent leakage along tie. Multiple rod ties do not require washers.

5. When tapered, ties are used, large end shall be placed on liquid side of tanks and water-retaining structures. Tapered ties shall be completely removed. The Contractor shall submit the methods and materials to be used to fill the voids thus formed for Engineer's review and approval.

K. Chamfer strips shall be placed in corners of forms and at all exposed edges to produce a beveled edge on permanently exposed surfaces. Chamfers shall be 3/4 inch or as noted on Drawings. Chamfer strips shall be wood, metal, PVC, or rubber and shall be fabricated and installed to produce uniformly smooth and straight lines. Chamfer strips shall be mitered at changes in direction.

L. Control joints shall be located and constructed as shown on Drawings.

M. Dovetail slots for masonry anchorage shall be installed where shown on the Drawings or specified in Section 04200.

3.04 REMOVAL OF FORMS GENERAL

A. When repair of surface defects or finishing is required at early age, forms shall be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.

B. Top forms on sloping concrete surfaces shall be removed as soon as concrete has attained sufficient stiffness to prevent sagging.

C. Wood forms for wall openings shall be loosened as soon as can be accomplished without damage to concrete.

D. Ties shall be removed.

3.05 MINIMUM CONCRETE STRENGTH REQUIREMENTS FOR REMOVAL OF FORMS AND SHORING

A. Formwork for columns, walls, sides of beams and other elements not supporting the weight of concrete may be removed after curing for 24 hours.

B. Formwork for columns, walls, sides of beams and other elements supporting the weight of concrete joists, elevated slabs and other elements may be removed after curing for seven days. These forms may be removed after three days of curing if concrete has attained 80% of the specified design compressive strength.

C. Formwork and shoring used to support the weight of concrete beams, elevated slabs or other similar horizontal elements may be removed after 14 days of curing if concrete has attained 90% of the specified design compressive strength. Otherwise, these forms shall remain in place until either this strength is attained or 21 days have elapsed.

D. Removal strength shall be determined by testing specimens field cured along with concrete they represent. Testing laboratory shall perform strength tests as specified in Section 03300. All concrete testing performed for the purpose determining the timing of formwork removal shall be accomplished at the Contractor's expense.

E. Contractor is responsible for maintaining stability of the structure during construction when it is subjected to construction loads, wind loads and other loads after the forms have been removed.

F. Concrete structures shall not be filled with water, backfilled against or subjected to their design loads until 28 days after the commencement of curing or until field cured test cylinder specimens have reached the specified design compression strength. In no case shall concrete structures be loaded prior to curing for their specified minimum curing periods.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 03150
WATERSTOP

PART 1 GENERAL

1.01 SCOPE

A. This Section includes waterstop for cast-in-place concrete construction.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Product literature.

2. Information for the Record:

a. Manufacturer's installation instructions.

1.03 PRODUCT HANDLING

A. Store waterstops under tarps to protect from oil, dirt, sunlight and premature exposure to water.

PART 2 PRODUCTS

2.01 PLASTIC WATERSTOP (TYPES A AND B)

A. Plastic waterstop shall be constructed of highest-grade virgin Polyvinyl Chloride (PVC) and shall conform to US Army Corps of Engineers specification CRD-C 572. Minimum tensile strength shall be 2000 psi.

B. Waterstop shall have factory-installed hog rings along both edges at minimum 12-inch spacing.

C. Type A waterstop shall be 9 inches wide by 3/8-inch nominal thickness ribbed waterstop with a 1/2 inch inside diameter center bulb, Greenstreak, Inc. No. 735, or equal. Type A waterstop with split flange shall be Greenstreak No. 727, or equal.

D. Type B waterstop shall be 6 inches wide by 3/8-inch nominal thickness ribbed waterstop without center bulb, Greenstreak No. 679 or equal. Type B waterstop with split flange shall be Greenstreak No. 724, or equal.

2.02 TYPE C WATERSTOP

A. Type C waterstop shall be a hydrophilic rubber waterstop made from a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

B. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

C. Performance requirements of chloroprene rubber:

1. Tensile Strength (ASTM D412):
    a. 1,300 psi minimum.
2. Ultimate Elongation (ASTM D412):
    a. 400% minimum.
3. Hardness, Shore A (ASTM D2240):
    a. 50 plus or minus 5.
4. Tear Resistance (ASTM D624):
    a. 100 pound per inch minimum.

D. Performance requirements of chloroprene hydrophilic rubber:

1. Tensile Strength (ASTM D412):
    a. 350 psi minimum.
2. Ultimate Elongation (ASTM D412):
    a. 600% minimum.
3. Hardness, Shore A (ASTM D2240):
    a. 52 plus or minus 5.
4. Tear Resistance (ASTM D624):
    a. 50 pound per inch minimum.
5. Expansion Ratio (Volumetric Change - Distilled Water at 70 degrees F):
    a. 3 to 1 minimum.

E. Waterstop shall be Hydrotite manufactured by Greenstreak, or equal.

F. Nominal size of waterstops for construction joints shall be 10 mm high by 30 mm wide (Hydrotite CJ-1030-4M or equal) and nominal size of waterstops around pipes that penetrate concrete shall be 4 mm high by 20 mm wide (Hydrotite DSS0420 or equal), unless specified or noted otherwise.

G. Hydrotite adhesive by Greenstreak or equal.

H. Leakmaster sealant by Greenstreak or equal.

I. Cyanoacrylate adhesive by Greenstreak or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Concrete shall be carefully and thoroughly consolidated with vibrator machine around Type A and B waterstops.

B. New cast-in-place concrete surfaces shall be cast or troweled smooth. New and existing surfaces shall be cleaned of all oil, dirt and lattice under type C waterstops. Where existing surfaces are rough apply a swellable sealant (as specified in 2.02.H) base under the type C waterstops.

3.02 INSTALLING

A. Waterstop shall be installed in accordance with manufacturer's recommendations.

B. Types A and B Waterstops:

1. Waterstop shall extend entire length of joint and shall be centered so that half of waterstop is embedded on each side of joint, unless shown otherwise on Drawings.

2. Waterstop shall be continuous around corners and intersections to provide a continuous seal and to make a watertight structure.

3. Field splices shall be limited to straight butt splices. Intersections and transitions shall be made with fabricated and tested junction sections.

4. Splices shall be made with splicing iron in accordance with manufacturer's recommendations. Use of torch or direct flame is prohibited.

5. Dirt, grease, and splattered concrete shall be cleaned from waterstop and wire loops.

C. Type C Waterstops:

1. Waterstop shall extend entire length of joint and shall be continuous around corners and intersections to provide a continuous seal and to make a watertight structure.

2. Secure waterstop to concrete or penetrating pipes with a chloroprene rubber compatible adhesive approved by manufacturer. Apply the adhesive to both the concrete or pipe surface, and to the waterstop, and allow to dry to a tacky consistency, then place the waterstop into position.

3. Cut square and Glue spliced ends together with cyanoacrylate adhesive per manufacturer's recommendations.

4. Concrete shall be placed over the waterstop within 4 hours of placement. Prevent rain water, curing water and other sources of water from prematurely

activating the waterstop prior to concrete placement. Remove, clean surface and replace any waterstops that have been damaged or prematurely activated.

3.03 SCHEDULE

A. Waterstop shall be placed in following locations:

1. Joints in walls and slab below grade which separate occupiable space or equipment rooms from earth or water.
2. Joints at and below 100-year flood elevation indicated on the Drawings or as otherwise specified.
3. Joints in walls and slabs of liquid-retaining, conveying and secondary containment structures.
4. Other locations shown on Drawings or specified elsewhere.

B. Waterstop shall be Type B unless otherwise shown on the Drawings or specified elsewhere.

C. Waterstop shall be Type A in expansion joints unless otherwise shown on the Drawings or specified elsewhere.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes reinforcing steel, load transfer dowels, and accessories.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Placing drawings shall indicate:

1) Construction joints, splice locations, and splice lengths.

2) Bending schedules.

3) Accessories.

b. Product literature for mechanical splices and adhesives.

2. Information for the Record:

a. Mill certificates.

1.03 QUALITY ASSURANCE

A. Reinforcement shall be detailed, fabricated, and placed in accordance with following codes, standards, and specifications.

1. “Details and Detailing of Concrete Reinforcement (ACI 315)”, American Concrete Institute, and “Reinforcing Bar Detailing,” Concrete Reinforcing Steel Institute (CRSI).

2. “Manual of Standard Practice”, Concrete Reinforcing Steel Institute.

3. “Standard Tolerances for Concrete Construction and Materials (ACI 117)”, American Concrete Institute.

B. Concrete reinforcement shall be in accordance with “Building Code Requirements for Structure Concrete (ACI 318) and Commentary (ACI 318R)”, American Concrete Institute, and “Specifications for Structural Concrete for Buildings” (ACI-301).

C. All placing of reinforcing bars in the form shall follow the CRSI “Placing Reinforcing Bars.”

D. Concrete reinforcement for environmental engineering concrete structures (liquid retaining structures) shall also be in accordance with "Environmental Engineering Concrete Structures (ACI-350)," American Concrete Institute.

1.04 DETAILING

A. When splices are not indicated on Drawings, reinforcement shall be furnished so as to minimize splices. Horizontal rebar shall be spliced within the limits of adjacent pours to be poured later to allow for unrestrained shrinkage movements. Splice locations shall be subject to Engineer's approval. Contractor shall give sufficient advance notice satisfactory to Engineer's representative for his inspection upon completion of installation.

B. When slab or wall reinforcement is interrupted by openings or embedments, additional reinforcement shall be furnished as shown on Drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Bundles of reinforcing bars shall be tagged with weatherproof tags indicating quantity, grade, size, and Shop Drawing designation.

B. Bundles of welded wire fabric shall be tagged with weatherproof tags indicating quantity, style designation, width and length.

C. Reinforcement shall be stored off ground and shall be protected from oil, mud, and other deleterious substances.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing bars shall be grade 60 deformed bars conforming to ASTM A615 or ASTM A996.

B. Reinforcement to be welded shall be grade 60 bars conforming to ASTM A706.

C. Welded wire fabric shall be fabricated from underformed wire and shall conform to ASTM A185, except welded intersections shall be spaced not farther apart than 12-inch welded wire fabric shall be furnished in flat sheets.

D. Load-transfer dowels shall conform to ASTM A36 and shall be fitted with expansion sleeve. Dowel size shall be as indicated on Drawings.

2.02 BAR SUPPORTS

A. Bar supports in contact with forms shall be Class 1, maximum-protection, plastic-coated wire supports. Other bar supports may be Class 3, no-protection, wire supports.

B. Bar supports on grade shall be precast concrete blocks not less than 4 inches by 4 inches wired in place. Blocks shall have compressive strength not less than the specified compressive strength of concrete being placed.

C. Form spacers shall be all-plastic, snap-on devices, specifically designed to position reinforcing bars in concrete.

2.03 MECHANICAL SPLICE

A. Threaded mechanical splices and dowel bar replacements (DBR) shall be furnished where shown or otherwise permitted.

B. Mechanical splice and dowel bar replacement shall develop 125% of the specified reinforcement yield strength. The next larger size coupler shall be furnished at no additional cost to Owner when required to develop specified strength.

C. When dowel bar replacements are provided to facilitate future expansion, epoxy coated rebar couplers shall be used. Rebar couplers shall be greased and capped with threaded plastic plugs to make a watertight seal.

D. Mechanical splices and dowel bar replacements shall be as manufactured by Dayton Superior, Lenton, Bar Splice Products, Inc., or equal.

2.04 ADHESIVE

A. Adhesive for embedding reinforcement in existing structures shall be 100% solids, 100% reactive, epoxy conforming to ASTM C881, Type IV, Grade 3, Classes B and C. The adhesive shall be formulated to withstand the maximum allowable published loads permanently without creep or failure.

B. Bond strength to concrete per ASTM C882 shall be 1800 psi minimum at 7 days.

C. Adhesive shall be mixed in accordance with manufacturer's instructions.

D. The adhesive shall be type "HIT-RE-500-V3" manufactured by Hilti or equal. The "fast set" formulation of the "Power-Fast Epoxy" as manufactured by Powers/Rawl shall not be used.

2.05 FABRICATION

A. Reinforcement shall be accurately fabricated to dimensions shown on approved Shop Drawings. Bend dimensions shall conform to CRSI Manual of Standard Practice.

B. Bends shall be shop formed unless otherwise indicated. Radial fabrication (Type 9 Bars) may be furnished straight and sprung to fit when permitted by CRSI Manual of Standard Practice.

C. Reinforcement shall be cold bent, and shall not be bent or straightened in injurious manner.

PART 3 EXECUTION

3.01 COORDINATION

A. Reinforcement shall be accurately placed, supported, and tied prior to concrete placement. Reinforcement shall be subject to review of Resident Project Representative prior to placing concrete.

3.02 PREPARATION

A. Grade shall be leveled such that specified concrete cover is maintained.

B. When ground is too soft to support reinforcement, Contractor shall over excavate and construct concrete mud mat at no additional cost to Owner. Mud mat shall be minimum of 3 inches thick, unless noted otherwise.

3.03 ERECTION AND INSTALLATION

A. Reinforcement shall be placed in accordance with approved Shop Drawings.

B. Reinforcement and dowels shall be adequately supported and fastened before concrete is placed and shall be secured against displacement. Supports shall be placed at minimum of 4-feet centers.

C. Concrete cover for wall and column reinforcement shall be accurately maintained by use of form spacers or Class 1 bar supports.

D. Templates shall be furnished for placement of column dowels.

E. Load-transfer dowels shall be accurately aligned perpendicular to joint. Placing cages shall be used to ensure proper alignment.

F. Reinforcement shall be placed within the tolerances specified in ACI 117, but the required number of bars shall not be reduced. When it is necessary to move reinforcement to avoid interference with other reinforcement, conduits, or embedded items exceeding specified tolerances, the resulting arrangement of bars shall be subject to Engineer’s approval.

G. Driving or forcing reinforcement into concrete is prohibited.

H. Field bending or straightening of reinforcement is prohibited, except as specifically shown on Drawings. Bars with kinks or bends not shown on Shop Drawings are not permitted.

I. Welding of reinforcement is prohibited except as specifically shown on Drawings.

J. Unless specifically noted otherwise, welded wire fabric shall be installed near the top in slabs on grade (2 inches from the top of slab). Fabric should extend to within 2 inches of the joints and the edges of the slab. When used for temperature reinforcement in structurally reinforced elevated slabs, welded wire fabric shall be placed 3/4 inches

down from the top surface of the slab, unless otherwise shown, and shall extend into supporting beams and walls for anchorage unless an expansion joint is called for.

3.04 CONCRETE COVER

A. Concrete cover shall be as indicated on Drawings. If drawings do not specify concrete cover for reinforcement, it shall be in accordance with the requirements of ACI-301 and/or ACI-350 as applicable.

B. Allowable Tolerances in Concrete Cover shall be:

1. To formed surfaces: plus 1/4 inch

2. To unformed top surface: minus 1/4, plus 1/2 inch

3.05 LAP SPLICES

A. Splices shall be located as shown on approved Shop Drawings.

B. Bar lap splice shall be Class B splices and their lengths shall be as shown on Drawings.

C. Welded wire fabric shall be lapped a minimum of 2 cross wire spacings, but not less than 8 inches.

3.06 MECHANICAL SPLICES

A. Mechanical splices and dowel bar replacements shall be installed in accordance with the manufacturer's instructions.

3.07 WELDING

A. When welding of reinforcement is shown on Drawings, welding shall conform to "Structural Welding Code - Reinforcing Steel", (AWS D1.4), American Welding Society.

B. Tack welding and other welding not specifically shown on Drawings is prohibited.

3.08 FIELD BENDING

A. When bending or straightening of reinforcement partially embedded in concrete is shown:

1. Inside bend diameter shall be minimum of 6 bar diameters.

2. Beginning of bend shall not be closer to concrete surface than 6 bar diameters.

3. No. 5 bars and smaller may be cold bent the first time only when temperature is above 32 degrees F. Bars shall be preheated for subsequent bending or straightening.

4. Bars larger than No. 5 shall be preheated.

B. Preheating of Reinforcement shall be as follows:

1. Preheat shall be applied to length of bar equal to a minimum of 5 bar diameters each way from center of bend. Preheat shall not extend below surface of concrete. The temperature of the bar at concrete interface shall not exceed 500 degrees F.

2. Preheat temperature shall be 1100 degrees to 1200 degrees F. Temperature shall be maintained until bending or straightening is completed. Preheat temperature shall be measured by temperature measurement crayons or other acceptable method.

3. Reinforcement shall not be artificially cooled, until the material temperature is less than 600 degrees F.

C. Bending or straightening of bars other than specifically shown on Drawings is prohibited.

3.09 DOWELING TO EXISTING STRUCTURE

A. Dowels shall be embedded into existing concrete where shown on Drawings. Unsound concrete shall be reported to Engineer.

B. Adhesive dowels shall be placed in holes larger than the reinforcement diameter using a rotary percussion hammer and carbide bit. Hole diameters shall be as recommended by manufacturer for each specific reinforcing diameter.

1. Unless indicated otherwise, adhesive dowels shall be embedded as follows:

Stud Diameter	Minimum Embedment
#3	4-1/2 inches
#4	6 inches
#5	7-1/2 inches
#6	9 inches
#7	10-1/2 inches
#8	12 inches

C. Hole shall be cleaned of dust and residue by blowing the hole with dry and oil-free compressed air. Air nozzle shall be inserted to bottom of hole. The holes should also be brushed using a nylon brush to remove dust and other debris which may have been pressed into the walls of the hole.

D. Standing water and frost shall be removed immediately prior to injecting adhesive.

E. Adhesive shall be injected from bulk-loading caulking gun, disposable caulking tubes, or pneumatic dispenser. Adhesive shall be injected using extension on nozzle to reach bottom of hole. Adhesive shall be injected to pre-determined depth which will cause hole to be completely filled after bar is inserted.

F. Bar shall be inserted and slightly rotated to ensure adhesive completely surrounds bar.

G. Adhesive displaced from hole shall be removed immediately.

H. The manufacturer's installation guidelines for the specific adhesive chosen shall be strictly followed.

3.10 CLEANING

A. Reinforcement, at time concrete is placed, shall be free of mud, oil, or other materials that may adversely affect or reduce bond.

B. Reinforcement with rust, mill scale, or combination of both shall be considered satisfactory provided minimum dimensions, weight, and height of deformations of hand-wire-brushed test specimen are not less than applicable ASTM specification requirement.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, placing, finishing, and curing cast-in-place concrete. Miscellaneous materials required for concrete construction are included.

B. Anchor bolts and other cast-in items are furnished under other Sections.

C. The Contractor, before commencing Work, shall examine all adjoining Work on which this Work is dependent for proper installation and workmanship according to the intent of this specification, and shall report to the Engineer any condition which prevents this Contractor from performing first class work.

D. Laboratory services for quality control shall be furnished in accordance with requirements of Section 01410.

E. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

    a. Concrete mix designs including substantiating data and test records. Concrete Mix Design, Proportioning.

    b. Product literature for admixtures, curing compounds, and miscellaneous materials.

    c. Locations of construction and control joints not shown on Drawings, and proposed changes in locations.

    d. Material certifications.

    e. Aggregate gradation and percentages of deleterious substances.

    f. Batch plant certification.

2. Information for the Record:

    a. Manufacturer’s application instructions for miscellaneous materials.

    b. Quality control test reports.

    c. Slab profile report.

B. Copy of concrete delivery ticket shall be presented to Resident Project Representative for each batch. Delivery ticket shall indicate:

1. Name of ready-mixed company and plant designation.
2. Truck number.
3. Concrete class.
4. Quantity of concrete.
5. Date.
6. Time when batch was loaded.
7. Type and name of admixtures.
8. Actual batch weights of cement, fly ash, aggregates, and water.
9. Location of pour and time of unloading shall be added to the ticket at Site.

1.03 QUALITY ASSURANCE

A. Batch Plant:

1. Batch plant shall be central batch plant with automatic or semi-automatic control. Concrete may be mixed using either central-mixed, shrink-mixed, or truck-mixed methods. If concrete is shrink-mixed or truck-mixed, the truck and concrete shall conform to ASTM C94.
2. Batch plant shall be certified by the Department of Transportation, National Ready Mixed Concrete Association (NRMCA) or an independent certification using NRMCA “Check list for Certification of Ready Mixed Concrete Production Facilities” executed and certified by independent Professional Engineer registered in state of Site. Evidence of current certification shall be submitted.

B. Pre-installation Conferences:

1. Before beginning concrete work, Contractor shall hold a meeting to review detailed requirements for preparing concrete mix designs and to determine proper procedures for concrete construction. A representative of Contractor, testing laboratory, concrete producer, concrete pumping contractor, and Engineer shall be in attendance.
2. Contractor shall submit for Engineer review a plan showing the locations of all proposed construction and control joints, which are not shown on the construction Drawings, and a schedule that incorporates the alternating pour sequences required to allow for strength gain and control of volumetric shrinkage changes.
3. When dry-shake floor hardener or metallic topping is specified, manufacturer’s representative shall instruct Contractor on proper equipment and application procedures.

C. Concrete work shall be in accordance with the current edition of the following codes, standards and specifications:

1. American Concrete Institute (ACI).

2. “Manual of Standard Practice”, Concrete Reinforcing Steel Institute (CRSI).

1.04 DELIVERY AND HANDLING

A. Concrete shall be delivered in accordance with ASTM C94 except the time limit for discharging of concrete during hot weather shall be reduced as specified.

B. Concrete shall be delivered in agitating trucks or in mixing trucks operating at agitating speed.

1.05 ENVIRONMENTAL CONDITIONS

A. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow, or when inclement weather is imminent.

B. Cold Weather:

1. Cold weather concreting procedures per “Cold Weather Concreting,” ACI 306R, shall be followed whenever any one of the following conditions occur or are expected to occur:

a. The air temperature is below 40 degrees F at the time of concrete placement.

b. The average daily air temperature is below 40 degrees F for three consecutive days immediately prior to the day of concrete placement.

c. An average daily air temperature below 40 degrees F is foreseen or occurs during any day of the specified concrete curing period.

2. For purposes of the paragraphs above, the average daily temperature is defined as the arithmetic mean of the highest and lowest temperature during the period from midnight to midnight. All air temperatures are to be measured at the Site.

C. Hot Weather:

1. Hot weather concreting procedures per “Hot Weather Concreting,” ACI 305R, shall be followed whenever any one of the following conditions occur or are expected to occur:

a. The air temperature is above 90 degrees F at the time of concrete placement.

b. Whenever conditions of concrete temperature, air temperature, wind velocity, and relative humidity combine to cause flash set, excessively low slump, cold joints, plastic shrinkage cracking, or otherwise impair the quality of concrete,

2. When the evaporation rate of bleed water exceeds 0.1 pounds per square foot per hour, steps shall be taken to prevent plastic shrinkage cracking. Evaporation rate shall be determined by the method presented in "Hot Weather Concreting," ACI 305R.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement - ASTM C150 Type I or II, unless indicated otherwise. All cement shall be from the same mill. Cement for Class A-2 concrete shall contain less than 8% tricalcium-aluminate (C3A).

B. Coarse Aggregate - Aggregates for normal weight concrete shall be crushed limestone conforming to ASTM C33, Class 4S. Aggregates for lightweight concrete shall meet the requirements of ASTM C330. Aggregates shall satisfy all quality requirements specified therein (i.e. grading, limits on deleterious substances, etc.).

C. Fine Aggregate - ASTM C33.

D. Fly Ash - ASTM C618, Class C or Class F, including supplementary chemical requirements and supplementary physical requirements, except loss-on-ignition shall be less than 5%. The use of fly ash shall be in accordance with "Use of Fly Ash in Cement (ACI-232.2R").

E. Silica Fume - ASTM C1240.

F. Ground Granulated Blast Furnace (GGBF) slag shall be in accordance with ASTM C989 Grade 100 or 120. Slag for Class A-1 concrete shall contain less than 12% tricalcium-aluminate (C3A) and slag for Class A-2 concrete shall contain less than 8% tricalcium-aluminate (C3A).

G. Admixtures - The use of all admixtures shall be in accordance with "Chemical Admixtures for Concrete (ACI 212.3R"), and "Guide for the Use of High Range Water Reducing Admixtures in Concrete (ACI 212.4R)."

1. Air entraining - ASTM C260.

2. Water-reducing - ASTM C494.

3. Accelerator - ASTM C494, Type C or E, admixture shall be non-corrosive as verified by long-term accelerated corrosion testing by an independent laboratory.

4. Anti-washout admixture - Master Builders "Rheomac UW450", or equal.

5. Only those admixtures expressly stated by the manufacturer as being chloride-free shall be used.

6. The maximum water-soluble chloride ion content, expressed as a percentage by weight of the cement, contributed from all concrete ingredients shall not exceed 0.10% for non-prestressed concrete structures. Written certification of

chloride ion content shall be submitted. Testing for Chloride Ion content shall conform to ASTM C1218.

7. If more than one admixture is used, the admixtures shall be compatible with each other and shall be incorporated into the concrete mix in correct sequence and timing so that desired effects of all admixtures are realized and harmful effects are avoided.

8. Air-entraining and chemical admixtures shall be incorporated into the concrete mix in a water solution. The water so included shall be considered to be a portion of the allowed mixing water.

H. Water shall conform to ASTM C94. Mixing water, including that contributed by aggregates and admixtures, shall be clean, and free from injurious amounts of oils, acids, alkalis, organic materials, chloride ions, or other substances that are deleterious to concrete or reinforcement. Non-potable water shall not be used.

I. Fiber reinforcement

1. Polypropylene fiber reinforcement shall be 1-1/2-inch-long fibrillated polypropylene fibers with UL rating and conforming to ASTM C1116, Type III. Mesh shall be fabricated by SI concrete Systems, Inc., type “Fiber Mesh 300” or approved equal. The concrete mix shall be dosed with fibers at a rate of 1.5 pounds per cubic yard, unless recommended differently by the fiber manufacturer, and approved by the Engineer.

2. Steel fiber reinforcement shall be 2-inch-long corrugated low carbon, cold drawn steel fibers conforming to ASTM A820, Type I SI Concrete Systems, Inc., type “Novocon 1050” or approved equal. The concrete mix shall be dosed with fibers at a rate of 25 pounds per cubic yard, unless recommended differently by the fiber manufacturer, and approved by the Engineer.

2.02 ACCESSORIES

A. Curing Compound - Compound shall be membrane-forming, liquid applied, non-yellowing, VOC-compliant, water-based acrylic polymer resin conforming to ASTM C309, Type 1 and ASTM C1315, Type 1, Class A. The compound shall include sealing and dustproofing properties. Minimum solids content shall be 25%. Compound shall not permit a moisture loss in excess of 0.40 kilograms per square meter (0.082 pounds per square feet) in 72 hours. Sodium silicate based products are not acceptable. Compound shall be Dayton Superior “Cure & Seal 1315 J22WB”, SpecChem, LLC. “Cure & Seal WB 25”, L&M Construction Chemicals, Inc. “Lumiseal WB Plus” or equal. Curing compound in potable water treatment plant construction shall be non-toxic and free of taste and odor.

B. Bonding Adhesive for Cracks, etc. - ASTM C881 100% solids, 100% reactive two component epoxy bonding adhesives. Sika Corporation, “Sikadur 32, Hi-Mod”, Dayton

Superior “Sure Bond (J-58)”, The Euclid Co. “Dural 452 Gel”, Master Builders “MasterEmaco ADH326”, or equal.

C. Bonding Adhesive for Vertical Joints - Non-vapor barrier forming, solvent-free, moisture insensitive, epoxy modified cementitious product Sika Corporation “Sika Armatec 110 Epocem”, Euclid Co. “Duralprep A.C.” or equal.

D. Bonding Grout - Identical concrete mix as approved for each concrete Class, except that an identical quantity of the fine aggregate shall be substituted for all coarse aggregate.

E. Liquid Floor Hardener – A VOC compliant, Non-yellowing, dust proofing, liquid applied hardener with non-slip properties that dies to a clear finish. L&M Construction Chemicals “Seal Hard”, W.R. Meadows “Liqui-Hard”, ChemMasters “Chemisil Plus”, or equal. Apply after concrete has cured as recommended by the manufacturer.

F. Bond Breaker - Bond breaker shall be non-staining type which will provide a positive bond prevention, such as SpecChem “SpecTilt 100”, Nox-crete “Silcoseal Classic”; or equal.

G. Premolded Expansion Joint Fillers:

1. Exterior Walks and Pavements - Asphalt impregnated cellular fibers securely bonded together, in conformance with ASTM D1751. W. R. Meadows “Fibre Expansion Joint”, J D Russell Company “Fiberflex”, or equal.

2. Other Locations - Self expanding cork type in conformance with ASTM D1752, Type III. W.R. Meadows, Inc. “Sealtight - Self-Expanding Cork Joint Filler”, Masco “Self Expanding Cork”, or equal.

H. Isolation Joints - Flexible foam expansion joint filler, W.R. Meadows “Sealtight - Ceramar”, or equal.

I. Compressible Material - Rigid extruded polystyrene from Board Foamular 150 (15psi) by Owens Corning Company or compressible fill material by Plasti-Fab or equal. Provide foam board, unless noted otherwise.

J. Epoxy Joint Filler - Two component, 100% solids, flexible epoxy filler with minimum Shore D hardness of 50. The Euclid Chemical Company “Euco 700”, Sika Corporation “Sikadur 51 SL”,W.R. Meadows, Inc “Rezi-Weld Flex”, or equal. Only to be used to fill interior non-moving saw cut or tooled construction or control joints and shrinkage cracks. Not suitable for constant immersion.

K. Non-slip Aggregate Floor Treatment - Aluminum oxide or emery grit. BASF chemical company “Master Top 120SR”, Dayton Superior “Emery Non-slip”, or equal.

L. Vapor Barrier - 6 mil polyethylene, ASTM D2103.

2.03 CONCRETE MIXES

A. Contractor shall design and be responsible for the performance of all concrete mixes. Mixes shall have the required quality, consistency, and workability to permit concrete to

be readily worked into forms and around reinforcement without segregation or excessive bleeding. Hardened concrete shall develop all characteristics required by Contract Documents

B. Proportioning:

1. Concrete mixes shall be proportioned to maximize durability and water tightness. To this end the total water content shall be reduced to the lowest practical amount that is consistent with placing and consolidation methods. Water reducing and high range water reducing admixtures shall be used as required to maintain workability. Specified water/cementitious ratio shall not be exceeded.

2. Concrete proportions shall comply with ACI 211.1, ACI 301, ACI 318 and for the environmental components of the Work ACI 350.

a. Proposed mix designs proportioned by field test data or trail mixes shall be accompanied by a complete standard deviation analysis and calculations for the required average compression strength F`cr. Test records used for determining standard deviation and average strength shall have been made within the past 12 months. These test records must represent materials, quality control procedures and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for the proposed Work. A minimum of ten concrete compressive test records are required if field test data is selected as the method to determine the validity of the proposed mix design.

b. Proportioning by empirical methods on basis of water/cement ratio is not permitted.

c. Concrete mix proportions are subject to Engineer's approval.

C. Design mixes shall have following requirements:

1. Three normal weight concrete mixes are generally required; Class A-1, A-2and Class B. Concrete mixes shall be as follows:

	Class A-1	**Class A-2 (Wastewater)**	**Class B**
28-Day Compressive Strength f'c (psi)	4500	4500	3000
Maximum Water/Cementitious Ratio:	0.44	0.42	.66
Minimum Cementitious Content (Lbs/CY)	600	650	480
Maximum Cementitious Content (Lbs/CY)	800	800	650
Slump (Inches)	See below	See below	See below

For calculating water/cementitious ratio of the mix, the weight of the water shall be that of the total free water in the mix, which includes the mixing water, the water in any

admixture solutions, and any water in the aggregates in excess of that needed to reach a saturated surface dry condition.

2. Concrete placed under water shall contain an approved anti-washout admixture and shall contain a minimum of 600 pounds of cement per cubic yard. Fly ash or GGBF slag shall not be used in the concrete mix.

D. Slump:

1. When superplasticizer is not included in the mix, slump shall be 2-4 inches.

2. When superplasticizer is included in the mix, the maximum slump measured upon delivery to the construction site shall be 3 inches. Superplasticizer shall be added at the Site after verification of slump to increase slump to the desired amount.

3. Tolerance of 1 inch above the maximum specified slump will be permitted for one batch in any five consecutive batches.

4. Concrete of lower slump than specified may be used provided it is properly placed and consolidated. Field adjustment of slump by addition of water is not permitted.

E. Air Content:

1. All concrete shall be air entrained unless specified or noted otherwise on the Drawings.

2. Concrete to be air-entrained shall have an air content as schedule below, unless specified otherwise:

Nominal maximum size of coarse aggregate (inch)	ASTM C33 Aggregate Size number	Total air content percent by volume
3/8	8	7.5
1/2	7	7.0
3/4	67	6.0
1	57	6.0
1-1/2	467	5.5

3. Allowable deviation from specified air content is plus or minus 1%.

4. Interior floor slab specified to receive a trowel finish shall not be air entrained. Maximum air content shall be 3%.

5. Floors receiving dry-shake hardeners or heavy-duty topping shall not be air-entrained. Maximum air content shall be 3%.

6. Air entrainment is not required for Class B concrete.

F. Coarse Aggregate Size:

1. Nominal maximum size of aggregate shall not be more than one-fifth of narrowest dimension between side forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between reinforcing bars.

2. Coarse aggregate shall be largest size consistent with placing methods and specified constraints. Minimum coarse aggregate shall be Size Number 57, unless smaller size is required by dimensional or reinforcement spacing constraints.

G. Cementitious Material:

1. The cementitious mixture shall contain cement and either fly ash or GGBF slag, but not both.

2. When fly ash is used in the concrete mixture, it shall comprise between 15% to 25% of the total cementitious mixture. When slag is used in the concrete mixture, it shall comprise between 25% to 50% of the total cementitious mixture. The percentages are based on weight of the total cementitious mixture.

3. For concrete in contact with wastewater, Class A-2, the cementitious design mixture shall consist of ASTM C150 Type II cement and slag or ASTM C150 Type II cement and Class F fly ash. Alternately, ASTM C150 Type I cement and Class C fly ash may be used provided the design cementitious mixture is tested per ASTM C1012 to have 0.10% or less expansion in 6 months. The test results shall be submitted with the proposed concrete mix design.

4. Air content for concrete containing fly ash shall be closely monitored and the dosage of air-entraining admixture shall be modified as required.

2.04 CONCRETE PRODUCTION

A. Ready-mixed concrete is to be used unless otherwise specified. It shall be batched, mixed, and transported in accordance with ASTM C94.

B. Admixtures other than air-entraining admixture shall not be added without Engineer's written approval.

C. Admixtures shall be charged into mixer as solutions and shall be measured by means of acceptable dispensing device. If two or more admixtures are used, they shall be added separately. Admixtures shall be used in accordance with manufacturer's instructions.

D. During cold or hot weather conditions, special precautions, as specified in ACI 306R or ACI 305R, respectively, shall be taken during batching, mixing, and curing.

2.05 STORAGE OF MATERIALS

A. Cement shall be stored in weathertight containers.

B. Aggregate stockpiles shall be arranged to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. Frozen or partially frozen aggregates shall not be used.

C. Sand stockpiles shall be allowed to drain to ensure a relatively uniform moisture content throughout the stockpile.

D. Admixtures shall be stored in a manner to prevent contamination, evaporation, freezing, or damage. Admixtures in the form of suspensions or nonstable solutions shall be agitated to assure thorough distribution of ingredients. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.

PART 3 EXECUTION

3.01 COORDINATION

A. Reinforcement, sleeves, inserts, anchors, and embedded items shall be accurately placed, supported, and tied prior to concrete placement. Other trades and contractors required to furnish embedded items shall be given ample notice of concrete placement. Reinforcement and embedded items shall be subject to review of Resident Project Representative prior to placing concrete.

B. Contractor shall notify Resident Project Representative a minimum of 24 hours before placing concrete, excluding non-working days.

C. Concrete shall be placed only between hours of 8:00 a.m. and 6:00 p.m. unless otherwise permitted. Concrete shall not be placed after 12:00 noon on last working day of week.

3.02 PREPARATION

A. Hardened concrete and foreign materials shall be removed from inner surfaces of conveying equipment.

B. Waterstop shall be secured in place to ensure that it cannot bend to form cavities during concreting.

C. Formwork shall be completed and snow, ice, and water shall be removed from forms. Before placing reinforcing steel or concrete, the surfaces of the forms shall be covered with an acceptable coating material, or form liner may be used.

D. The space to receive concrete shall be free of laitance, dirt, and other debris. Laitance shall be removed by wire brushing.

E. Reinforcement and embedded items shall be checked for proper placement and adequate support. All reinforcement at the time concrete is placed, shall be free of mud,

oil, or other materials that may adversely affect or reduce the bond. Aluminum conduits or pipes shall not be embedded in concrete unless approved by the Engineer and effectively coated to prevent aluminum-concrete reaction.

F. Preparation of grade shall be as specified for slabs. Concrete shall not be placed on frozen ground. There shall be no standing water on the subgrade, nor any muddy or soft spots when the concrete is placed.

G. A final detailed inspection of the foundation, construction joints, forms, waterstops, embedments, reinforcements, and other items of the placement shall be made immediately before the concrete is placed.

3.03 PLACING CONCRETE

A. Conveying:

1. Concrete shall be handled from mixer to place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will ensure that required quality of concrete is maintained. Conveying systems shall not impair the strength, slump, or air content of the concrete. Concrete shall be placed and consolidated prior to initial set, and in no case more than 1-1/2 hours after the cement is added to the mix.

2. Chutes shall be metal (except aluminum), or wood with metal lining and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-feet long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.

3. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled to prevent segregation. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 inch.

4. Concrete shall not be permitted to drop more than 4 feet freely, or through a cage of reinforcing steel, from conveying device. Concrete shall be deposited through drop chutes, elephant-trunks, or tremies as required. Temporary openings in wall or column forms may be used to limit the free fall of concrete to less than four feet. The openings should be spaced no more than six to eight feet apart.

5. Concrete shall not be conveyed through pipes made of aluminum or aluminum alloy.

B. Depositing:

1. Concrete shall be deposited continuously or in layers of such thickness that no concrete will be deposited which has hardened sufficiently to cause planes of weakness within the sections. No interruption in concrete placement shall exceed 30 minutes to avoid cold joints in the structural elements being placed.

Alternate placing equipment shall be immediately available for use in the event that the primary placing equipment or system breaks down.

2. Placing shall proceed at such a rate that concrete which is being integrated with fresh concrete is still plastic.

3. Concrete which has partially hardened or has been contaminated shall not be deposited.

4. Placing of concrete for supported elements, such as beams and elevated slabs, shall not begin until supporting elements, such as columns and walls, have cured for a minimum of 7 days, unless the concrete has attained 80% of the specified design compression strength or the shoring for the supporting elements has been designed to carry the weight of the supported elements and their construction load.

5. Concrete shall be placed continuously between construction, isolation, and expansion joints. Where joints are spaced greater than 25 feet apart the placing of concrete adjacent to previously placed concrete shall not begin until 48 hours after completion of previous placement, unless otherwise noted. Concrete shall be deposited as nearly as practical in its final position and shall be carried up evenly in forms to avoid segregation due to rehandling or flowing. Layers shall not exceed 24 inches. Concrete shall not be permitted to flow laterally in forms.

6. The temperature of the concrete mixture immediately before placement shall be between 50 degrees F and 90 degrees F, except as provided under cold weather and hot weather concreting.

C. Consolidating:

1. Concrete shall be consolidated by vibrating, so that concrete is thoroughly worked around reinforcement and embedded items, and into corners and angles of forms, eliminating air and stone pockets. Vibrators shall extend into underlying layers to bond two layers together. To avoid excessive pressure on the forms, the vibrator should penetrate no more than two feet into the underlying layer.

2. Vibrators shall be the largest size and most powerful that can be used properly in the Work, as described in “Recommended Practice for Consolidation of Concrete” (ACI 309R). A minimum of one spare operable vibrator shall be available on site. Mechanical high frequency vibrators with a minimum frequency of 8,000 revolutions per minute are preferred for consolidation of concrete within the forms.

3. Vibrators shall not be used to transport or drag concrete within forms. Vibrators shall be inserted and withdrawn from the concrete slowly.

4. Vibrators shall be inserted in the fresh concrete at points approximately 18 inches apart or as recommended by the vibrator manufacturer. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the

concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

D. Defective Concrete:

1. Defective concrete is defined as concrete in place which does not conform to specified design strength, required percent air, shapes, alignments and elevations, as shown on the Drawings and/or which presents faulty surface areas. Evaluation and acceptance of concrete shall conform to ACI 318 and as determined by Engineer.

2. All defective concrete shall be removed and replaced in a manner meeting with the Engineer's approval. Should surface imperfections occur, they may be patched at the discretion of, and in a manner satisfactory to the Engineer. The Engineer reserves the right to require complete removal and replacement of such defective Work should the patching fail to satisfactorily restore the required quality and appearance of the Work. All such Work shall be performed at the Contractor's expense, without extension of time.

3. If for any reason, in the opinion of the Engineer, the testing of any section of the completed structure is necessary, a superimposed load shall be applied by the Contractor and the test conducted in accordance with the current Building Code at the Contractor's expense irrespective of the results of such tests. In cases where failure is declared, the Engineer shall have the authority to order the defective construction removed. All expense of removing such defective construction and substituting new construction, including expense of removing and replacing the Work of others, or protecting and repairing the Work of others, shall be borne by this Contractor.

3.04 JOINT INSTALLATION

A. Construction Joints:

1. Construction joints shall not be spaced further apart than 60 feet, unless noted otherwise. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated so that adjacent sections are placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks. Joints shall be located where they will least impair the strength, watertightness, and architectural design of the finished structure. Joint types and locations shall be subject to Engineer's approval. Construction joints shall not be located less than 5 feet from any other joint to which they are parallel.

2. Joints in walls and columns shall be placed at the tops of footings and mat foundations, unless shown otherwise. Joints should be made perpendicular to the main reinforcement where practical.

3. Joints shall be constructed straight by means of a temporary straight edge or rustication strip placed in forms. Joints shall be perpendicular to reinforcement.

4. Reinforcement shall be continuous across construction joints unless otherwise indicated. Unless otherwise specified or shown on Drawings, longitudinal keys at least 1-1/2 inches deep by 3-1/2 inches wide shall be provided in all joints in walls, and between walls and slabs or footings.

5. Surface of concrete shall be thoroughly cleaned and laitance shall be removed by wire brushing prior to placing adjoining concrete.

6. At all vertical joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding adhesive paste shall be applied per the manufacturer's directions.

7. At all horizontal joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding grout shall be applied in a 2-inch-thick layer.

B. Expansion and Isolation Joints:

1. Expansion and isolation joints shall be located and constructed as shown. Generally, joints shall be located at the perimeter of slabs-on-grades and other locations shown. These joints shall have filler material and have exposed faces sealed.

2. Reinforcement and other embedded metal items shall not extend continuously through expansion or isolation joints unless shown otherwise.

3. Unless polystyrene foam boards are called for on Drawings, premolded type joint fillers shall be installed for expansion joints in accordance with manufacturer's instructions. Joint filler shall be accurately placed and secured. Fillers for each joint shall consist of as few pieces of material as possible. Pourable or non-sag joint sealants per Section 07900 shall be placed in top or face of joints, as applicable, per manufacturer's instructions. All joints in tanks and within buildings shall be sealed unless otherwise shown. Where called for on the Drawings, exterior joints in or around walks and pavement shall be sealed.

C. Control Joints:

1. Unless indicated otherwise on the Drawings, control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness in both directions with a maximum aspect ratio not to exceed 2 to 1. These joints shall preferably be located on column lines with joints also located between column lines if required to satisfy maximum spacing. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-feet maximum spacing. All control joints shall be continuous, not staggered or

offset. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

3.05 FINISHING OF FORMED SURFACES

A. Surface defects shall be patched. Patching procedures shall be as follows:

1. Honeycombed and other defective concrete shall be removed to sound concrete. Cut or chip edges perpendicular to surface or slightly undercut; featheredging is not permitted. Area to be patched and surrounding area within at least 6 inches shall be dampened to prevent absorption of water from patching mortar.

2. Bonding grout consisting of 1-part cement and 1-part fine sand passing a No. 30 mesh sieve mixed to the consistency of a thick cream, shall be thoroughly brushed into surface immediately prior to applying patching mixture.

3. Patching mixture shall be composed of same proportions as used for concrete except that coarse aggregate shall be omitted and mixture shall not consist of more than 1-part cement to 2-1/2 parts sand by damp loose volume. Mixing water shall be no more than necessary for handling and placing. Patching mixture shall be prepared in advance and allowed to prehydrate with frequent manipulation with trowel, until stiffest consistency that will permit placement is obtained.

4. Where concrete is exposed to view, color of patching mixture shall be adjusted to match surrounding concrete by substituting appropriate amount of white cement for gray cement. Proper color shall be determined by trial patches.

5. Patching mixture shall be applied before bond coat begins to lose water sheen. Patching mixture shall be thoroughly consolidated and struck off so as to leave patch slightly higher than surrounding surface. Patch shall be left undisturbed for one hour after which time it shall be finished with metal tools. Patched area shall be moist cured for not less than 7 days.

B. Tie holes shall be patched as follows:

1. The holes shall be plugged, unless stainless steel noncorrosive or acceptably coated ties are used, as approved by Engineer.

2. Tie holes shall be cleaned and dampened prior to patching with a non-metallic, non-shrink grout. Patching material shall be packed solid into hole.

3. Contractor may substitute alternate materials and procedures subject to the approval of Engineer. These materials shall be applied in accordance with manufacturer’s written recommendations wherever applicable.

C. Stains, rust, efflorescence, and surface deposits on exposed concrete shall be removed by methods acceptable to Engineer.

D. After removal of forms, the surface of concrete shall be given one or more of the finishes specified below as scheduled in the Finishing Schedule of this specification.

1. Rough Form Finish - Fins exceeding 1/8 inch in height shall be removed. Otherwise surfaces shall be left with texture imparted by forms.

2. Smooth Form Finish - The form facing material with or without form-liner shall produce a smooth, hard, uniform texture in the concrete. The type of facing material or form-liner selected is dependent upon the type of smooth finish desired and shall be approved by the Engineer. Tie holes and defects shall be patched. All fins shall be completely removed.

3. Special Architectural Finishes - This shall be produced in accordance with Section 6 of ACI 301R.

4. Smooth Rubbed Finish - The smooth rubbed finish shall be produced on a concrete with smooth form finish as specified above.

    a. Forms shall have been removed and patching completed as soon after placement as possible without damaging or jeopardizing structure.

    b. Finishing shall be performed no later than the day following form removal.

    c. Surfaces shall be thoroughly wetted and rubbed with abrasive until form marks, fins, and irregularities are removed and uniform color and texture are produced. Cement grout shall not be used.

5. Grout Cleaned Finish - The grout cleaned finish shall be produced on a concrete with smooth form finish as specified above.

    a. Cleaning shall not begin until all contiguous surfaces to be finished are completed and accessible. Finishing as the Work progresses is not permitted. Finishing of an area shall be completed on day it is started.

    b. Finishing grout shall consist of 1-part cement and 1-1/2 parts fine sand with sufficient water to produce consistency of thick paint. Where concrete is exposed to view, color of grout shall be adjusted to match surrounding concrete by substituting appropriate amount of white cement for gray cement. Proper color shall be determined by trial patches.

    c. Wet surface sufficiently to prevent absorption of water from grout and apply grout uniformly with brushes or spray gun. Scrub surface vigorously with cork float to coat surface and fill air bubbles and holes. While grout is still plastic, remove excess grout with rubber float or burlap. After surface whitens from drying, rub vigorously with clean burlap. Finish shall be kept damp for minimum of 36 hours after final rubbing.

E. Finishing of Related Unformed Surfaces:

1. Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after placement and shall be floated to texture consistent with that of adjacent formed surface. Where smooth rubbed finish or grout cleaned finish is specified, finish shall continue uniformly across unformed surfaces.

3.06 SLAB INSTALLATION

A. Floor construction shall comply with ACI 302R. Floors shall be Class 5 except floors with heavy-duty topping shall be Class 7.

B. Preparation - Subgrade supporting slabs shall be well drained and of adequate and uniform load bearing capacity. Subgrade shall be free of frost before concrete is placed. Subgrade shall be moist at time of placement. Ground may be dampened with water, but there shall be no standing water on subgrade, nor muddy spots.

C. Vapor barriers shall be installed in all occupied spaces or where shown on Drawings. A minimum 4-inch layer of granular, self-draining compactable fill, shall be placed under the vapor barrier. Joints shall be lapped 6 inch minimum. Caution shall be taken during construction not to tear or otherwise damage the vapor barrier. Damaged vapor barriers shall be patched or replaced.

D. Floors and slabs shall be sloped to drains as shown maintaining thickness shown on Drawings as a minimum. When formwork is cambered, screeds shall be set to like camber to maintain proper concrete thickness.

E. A minimum of 1/4 inch per foot slope shall be provided for exterior slabs, driveways, and walks. Driveways and walks can be pitched to one side or crowned along the longitudinal centerline with drainage to both sides as most suitable to surrounding drainage pattern.

F. Concrete shall not be deposited more rapidly than it can be spread, straight-edged, and darby or bull-floated. These later operations shall be completed before bleed water collects on surface. Rakes shall not be used for spreading concrete to avoid segregation. Slabs shall be consolidated by internal vibrators of high frequency and low amplitude, or vibrating screeds.

G. Placement of large slab areas shall be sequenced to reduce initial shrinkage cracks. Such slabs can be poured in a series of long strips separated by similar long strips poured at another time. The adjacent pours shall be at least 48 hours apart. Placing sequence and number of pours are subject to the approval of Engineer.

H. Construction joints shall not be spaced further apart than 60 feet in both directions. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated, in a strip or checkered fashion, so that adjacent sections can be placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks.

I. Control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness, in both directions, with a maximum aspect ratio not to exceed 2 to 1, unless noted otherwise. These joints shall be located on column lines where practical. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-feet maximum spacing. All control joints shall be continuous, not staggered or offset, where practical. Saw-cutting of control joints shall be performed with "Soff-Cut" saw after final finishing as soon as the concrete surface is firm enough not be torn or damaged by the blades and prior to the application of curing compound. In any case, saw-cutting of joints shall be done within two hours after final finishing. Control joint shall be 1/8-inch-wide by one inch deep. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

J. Finishes:

1. Scratched Finish - After concrete has been placed, consolidated, struck off, and leveled, but prior to final set, surface shall be roughened with rakes.

2. Floated Finish - After concrete has been placed, consolidated, struck off, and leveled, surface shall not be worked further until ready for floating. Floating shall begin when bleed water sheen disappears and surface has stiffened sufficiently. Floating shall be performed with wood hand float or power float. During first floating, high spots shall be cut down and low spots shall be filled. Slab shall be refloated immediately to uniform sandy texture.

3. Troweled Finish - Surface shall first be float finished, followed by power trowel, and then hand troweled. Additional trowelings shall be performed after surface has hardened sufficiently. Final troweling shall be done when ringing sound is produced as trowel is moved over surface. Finished surface shall be free of trowel marks and uniformly smooth and hard. Dusting surface with cement is not permitted.

4. Broom Finish - Surface shall first be float finished and then given coarse texture by drawing broom over surface.

5. Non-Slip Finish - Non-slip abrasive aggregate shall be applied in accordance with manufacturer's instructions.

K. Finishing Tolerances:

1. Floor flatness (FF) and floor levelness (FL) tolerance for slabs on grade with trowel finish shall be FF25/FL20. Minimum local tolerance over 2 bay shall be 2/3 of specified tolerance.

2. Floated finish surfaces shall be constructed to tolerance of FF 20/FL17.

3. FL shall not apply to slabs where slope is shown or specified.

4. Testing laboratory shall determine slab profiles for the first trowel finish slab and first float finished slab on the project to verify that the proposed construction procedures will conform to specified tolerance.

L. Liquid hardener shall be applied to interior exposed concrete floors which do not receive paint, dry-shake hardener, or other coating, or floor coverings. Material shall be applied in accordance with manufacturer's instructions. Remove curing, sealer and dustproofing compounds prior to placing the liquid hardener.

M. Construction and control joints shall be filled with epoxy joint filler where shown. Joint filler shall be applied not sooner than 3 months after slab construction is completed and shall be installed in accordance with manufacturer's instructions.

N. Expansion and isolation joints shall be sealed using moisture insensitive and movement tolerating joint sealants per Section 07900.

3.07 CURING

A. Beginning immediately after placement, concrete curing shall be initiated to protect the concrete from moisture loss and premature drying. Concrete shall be continuously cured for a minimum of 7 days. Tanks and other liquid-retaining structures shall be cured for minimum of 10 days. Elevated slabs, joists, and beams shall be cured for at least 14 days and as many additional days as necessary for tests to verify that the concrete has attained 90% of its specified design strength up to a maximum of 21 days. For the entire duration of the curing period, the concrete shall be protected from detrimental weather conditions as specified elsewhere in this Section.

B. Curing procedures for each type of concrete section shall be submitted and shall be in accordance with ACI 308, "Standard Practice for Curing Concrete," subject to the additional requirements specified herein.

C. Concrete surfaces not in contact with forms shall be cured by one of following procedures:

1. Ponding, fog spraying, or continuous sprinkling with water. Care shall be taken to avoid thermal shock from use of cold curing water or excessive evaporation rates. Alternate drying and re-wetting of slabs during curing shall be avoided to avoid hairline cracks at the surface.

2. Application of burlap or absorptive mats kept continuously wet.

   a. Burlap shall be clean and thoroughly rinsed in water before it is used.

   b. Burlap and absorptive mats shall be soaked as frequently as required to maintain continuously wet surface.

   c. Burlap and absorptive mats shall remain in place unwetted for minimum of 3 days after end of curing period to permit concrete to dry slowly.

3. Application of waterproof sheet material conforming to ASTM C171.
    a. Sheet material shall be placed over the wet surface of fresh concrete as soon as possible without marring surface. Material shall be placed flat without wrinkles.
    b. Sheet material shall cover all exposed surfaces and shall extend beyond edges of slab a distance of at least twice the thickness of the slab.
    c. Sheet material shall be lapped a minimum of 6 inches. Windrows of earth or wood shall be placed along edges and laps to seal joints and secure material from displacement by wind.
4. Application of approved curing compound.
    a. Curing compound shall be used only after receiving approval by the Engineer.
    b. Curing compound shall not be used on walls to receive smooth rubbed or grout cleaned finishes, prior to the completion of the application of these finishes. Curing compound maybe applied, at contractor discretion, over these finishes to complete the curing processes.
    c. Curing compound shall not be used on surfaces to receive paint, liquid hardener, coatings, sealers, floor hardeners, tile, adhesives, or other materials requiring bond, unless positive measures are taken to remove it completely from the areas to receive bonded application.
    d. Curing compound shall be placed in accordance with manufacturer's instructions after finishing, and immediately after water sheen has disappeared from concrete surface.
    e. Exposed steel, keyways, or concrete to be surfaced shall be protected from curing compounds, unless the manufacturer of the surfacing material submits written documentation approving the use of their material on concrete on which the specific curing compound was applied.
    f. Curing compounds shall not be used on surfaces to receive concrete toppings. Refer to Section 03510.

D. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by sun shall be minimized by maintaining forms continuously wet.
1. Forms shall be continuously sprinkled or covered with wet burlap.
2. If forms are loosened but not removed, water shall be made to run down inside of form by use of soaker hoses.
3. If forms are removed prior to completion of curing period, concrete shall be cured by one of the methods specified for concrete surfaces not in contact with forms.

3.08 COLD WEATHER CONCRETING

A. Cold weather concreting procedures concerning production, transportation, placement, protection, curing, and temperature monitoring shall be submitted to Engineer for review prior to onset of cold weather.

B. Concrete Production:

1. Minimum concrete temperatures during mixing shall be as follows:

Air Temp	Least dimension less than 12 inch	Least dimension 12 inch or greater
30 to 45 degrees F	60 degrees F	55 degrees F
0 to 30 degrees F	65 degrees F	60 degrees F
Below 0 degrees F	70 degrees F	65 degrees F

2. The mixing temperatures shall not be more than 15 degrees F above the values given above. When necessary, in order to produce concrete of the specified temperature, the mix water, the aggregates, or both, shall be heated prior to batching. Heating shall be done in a manner which is not detrimental to the mix and does not prevent the entrainment of the required amount of air. The methods used shall heat the materials uniformly. Aggregates shall not be heated directly by gas or oil flame, or on sheet metal over fire. Neither aggregates nor water shall be heated to over 150 degrees F. If either are heated to over 100 degrees F, they shall be mixed together prior to the addition of the cement so that cement does not come into contact with materials which are in excess of 100 degrees F.

C. Preparation - All snow, ice, and frost shall be removed from the surfaces, including reinforcement, against which the concrete is to be placed. Concrete shall not be placed around any embedment which is at 32 degrees F or less and is sufficiently massive as to cause the adjacent concrete to freeze.

D. Placing - Minimum concrete temperatures at the time of placement shall be 55 degrees F for sections with smallest dimension less than 12 inches, and 50 degrees F for larger sections. Maximum concrete temperature shall not exceed 20 degrees F above the minimum required temperatures at the time of placement.

E. Protection:

1. Protection shall be provided and shall be adequate to prevent the surface temperature of the concrete from falling below 50 degrees F for the duration of the specified curing period. During this period, the concrete surface shall not be exposed to heated air that is more than 20 degrees F above this minimum value. At the end of the protection period, concrete shall be allowed to cool gradually. Maximum decrease in surface temperature shall be 5 degrees F in a one-hour period and 40 degrees F in a 24-hour period.

2. At the time of placement, Contractor shall keep a record of the date, time, outside air temperature, temperature of concrete, and weather conditions

(calm, windy, clear, cloudy, etc.). After placement, the Contractor shall keep a record of the date, time, outside air temperature, inside enclosure air temperatures, concrete surface temperatures and weather conditions for the duration of the specified curing period. These conditions shall be recorded at regular intervals, but not less than twice per each 24-hour period, with no period exceeding 16 hours without recorded conditions. The concrete surface temperatures shall be recorded at several locations on the placed section including interior, edge and corner locations and their corresponding enclosure air temperatures at these locations where applicable. These records shall be submitted to the Engineer or resident field representative weekly. The Contractor shall place a sufficient number of thermometers on the concrete surfaces throughout the Work to allow monitoring of concrete surface temperatures representative of all the Work. The Contractor shall place a minimum of two thermometers, each capable of recording the high and low temperature.

3. Materials and equipment required for protection shall be available at Site before cold weather concreting commences

4. Heated Enclosure:

   a. Enclosure shall be strong enough to be wind-resistant and weather-tight and ample space shall be provided between concrete and enclosure to permit free circulation of the warmed air.

   b. Maximum air temperature within enclosure shall be 70 degrees F.

   c. Heaters shall be indirect fired type and shall be vented outside of enclosure. Combustion products shall not be permitted to come in contact with protected concrete.

   d. Heaters and ducts shall be arranged so as not to cause areas of overheating or drying of concrete surface.

5. Insulation:

   a. Slabs not less than 12 inches thick placed on ground, elevated slabs, and walls may be protected by insulated forms and insulation blankets. Insulation shall be wind resistant and weather-tight.

   b. Insulation type and thickness shall be selected with due regard for concrete temperature, air temperature, and length of protection period in accordance with “Cold Weather Concreting” (ACI 306R). Special care shall be taken at corners and edges of structure. Insulation type, thickness, and “R” value shall be as indicated in cold weather concreting procedures.

   c. When minimum concrete temperature is not maintained, insulation shall be removed and immediately replaced by a heated enclosure. A

sufficient number of surface thermometers shall be furnished and installed as directed by Resident Project Representative.

F. Curing - If water curing is used, it shall be terminated at least 24 hours before concrete is exposed to freezing temperatures. Curing period shall be completed by non-water curing methods.

3.09 HOT WEATHER CONCRETING

A. Hot weather concreting procedures including production, transportation, placement, protection, and curing shall be submitted for Engineer's review prior to onset of hot weather.

B. Concrete Production and Delivery - The temperature of the concrete at time of placement shall be maintained within specified temperature by any combination of the following:

1. Type III cement is prohibited.

2. The temperature of the aggregates shall be kept low by shading the aggregate piles or sprinkling the aggregate with water.

3. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required to reduce concrete temperature. Mixing shall continue until ice is completely melted.

4. Delivery of concrete shall be scheduled so that concrete is deposited as soon as practicable. Concrete shall be completely discharged within 1 hour after introduction of mixing water to cement.

5. Water reducing or retarding admixtures with shrinkage compensating cement shall be used in such quantities as recommended by the manufacturer.

C. Preparation - Steel forms, reinforcement, and embedments shall be cooled to below 90 degrees F by means of spraying with water or other approved methods immediately prior to concrete placement.

D. Placing - Concrete shall be placed at lowest practicable temperature. Temperature of concrete as placed shall not cause difficulty from loss of slump, flash set, or cold joints and shall be between 75 degrees F and 90 degrees F and in no case shall exceed 90 degrees F.

E. Protection:

1. During hot weather conditions prior to the application of curing materials, the concrete being placed and finished shall be protected from damage due to rapid evaporation. Such protection shall be adequate to prevent premature crusting of surface or an increase in drying shrinkage and cracking. Such protection shall be provided by raising the humidity of the surrounding air by fog spraying, the use of wind breaks or sun shades, additionally reducing of the temperature of the concrete, scheduling placement during the cooler times of days or nights,

reducing time between placement of concrete and start of curing, or any combination thereof.

2. Forms shall be covered and kept moist.

F. Curing:

1. Curing shall be performed by water methods only unless approved otherwise.
2. When the use of waterproof sheet material is approved for hot weather concreting, the material shall be pigmented white.
3. Forms shall be loosened as soon as practicable and water curing shall be used as specified.

3.10 MASS CONCRETE

A. Concrete sections with minimum dimension larger than 36 inches shall be treated as mass concrete.

B. Concrete Production:

1. Type III cement and accelerating admixtures are prohibited.
2. Cement content shall be reduced by substitution of fly ash within specified limit.
3. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required to reduce concrete temperature. Mixing shall continue until ice is completely melted.

C. Placing:

1. The temperature of concrete when deposited shall be between 50 degrees F and 70 degrees F.
2. Concrete shall be placed in layers approximately 18 inches thick. Vibrator shall extend into previously placed layer.

D. Curing:

1. The curing period for mass concrete shall be a minimum of 14 days.
2. When the surrounding air temperature exceeds 40 degrees F, forms and exposed concrete shall be kept continuously wet for the first 48 hours after placing. Concrete shall be cured by any acceptable method after the first 48 hours, except when surrounding air temperature exceeds 90 degrees F, water curing methods shall be used exclusively. When cold weather concreting provisions apply, continuous wetting during first 48 hours is not required.
3. During and at conclusion of the curing period, the temperature of the air immediately adjacent to concrete shall not fall more than 3 degrees F in any 1 hour, nor 30 degrees F in any 24 hours.

3.11 TESTING

A. Concrete materials and operations shall be tested as the Work progresses.

B. Duties of testing laboratory shall be as follows:

1. Review, check, and test proposed materials for compliance with Specifications before the start of the Work.

2. Sample aggregates from concrete production stockpiles, at least once a month, during the placement of concrete and test for compliance with the specifications. The moisture content of each sample shall be measured and recorded.

3. Review and test proposed mixture design when required by Engineer.

4. Randomly sample concrete during construction in accordance with ASTM C172 and perform scheduled tests.

5. Measure and report surface profile of slabs in accordance with ASTM E1155. Surface profile shall be determined for first trowel finish slab and first float finish slab on project and other slabs specified.

C. Test Schedule:

1. Strength:

a. One strength test shall be made for each 50 cubic yards, or fraction thereof, of each class of concrete placed on any one day. Frequency of testing shall not provide less than 5 strength tests for each class of concrete.

b. Concrete strength test shall consist of three specimens from each sample molded and cured in accordance with the section of ASTM C31, “Curing Specimens for Checking the Adequacy of Mixture Proportions for Strength or as the Basis for Acceptance or Quality Control”.

c. Specimens shall be tested in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. Strength test result shall be average of strengths of 28-day specimens. If one specimen shows evidence of improper molding, handling, or testing, it shall be discarded and remaining specimen shall be considered as strength test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded.

2. Cold Weather Concreting and Form Removal:

a. When cold weather concreting procedures apply or when form removal provisions of Section 03100 apply, field cured specimens shall be made to determine when protection procedures may be terminated or when

forms may be removed. These field cured specimens shall be in addition to strength tests and shall be made at same time as strength specimens.

b. Specimens shall be molded and cured in accordance with the section of ASTM C31, "Curing for Determining Form Removal Time or When a Structure May be Put into Service". Contractor shall determine number of specimens required, but number of specimens shall not be less than three.

c. Specimens shall be tested in accordance with ASTM C39. Age-at-test of specimens shall be selected by Contractor.

3. Slump shall be measured for first batch of each concrete class delivered in morning and afternoon, for each strength test, and whenever consistency of concrete appears to vary. Slump shall be measured in accordance with ASTM C143. In the event that a batch fails to comply with specified requirements, the slump shall be measured on each successive batch until three batches meet the specified requirements.

4. Air content shall be determined for first batch of each concrete class delivered in morning and afternoon, for each strength test, and as required by field representative. Air content shall be measured in accordance with ASTM C231, ASTM C173, or ASTM C138. When concrete is placed by pumping, air content and slump shall be measured before pump and also at pump discharge. In the event that a batch fails to comply with specified requirements, the air content shall be measured on each successive batch until three batches meet the specified requirements.

5. Temperature of concrete sample shall be measured for each strength test.

6. If the measured slump or air content falls outside the specified limits, make additional tests immediately. Test all succeeding trucks for both slump and air until three in succession pass the slump and air tests.

3.12 EVALUATION OF STRENGTH

A. Contractor shall perform concrete mix work and produce concrete structures in full compliance with Specifications.

B. Concrete strength will be considered satisfactory if the average of three consecutive strength test results equals or exceeds the specified strength, and no individual strength test result falls below specified strength by more than 500 psi.

3.13 CONCRETE SCHEDULE

A. Unless indicated otherwise on the Drawings or specified, concrete shall be furnished as follows:

Class A-1: For all structures not defined under Class A-2 or Class B concrete.

Class A-2: For structures that cover, convey or store wastewater such as channels and tanks, and their attached auxiliary structures, and all other concrete that will be submerged or exposed to wastewater.

Class B: For pipe saddle supports, pipe pier supports, buried electrical duck banks, equipment pads, housekeeping pads and mudmats, unless noted otherwise. The above items shall not be exposed to weather and shall not be submerged in liquids; otherwise, they shall be of Class A concrete as specified above.

3.14 CONCRETE FINISHING SCHEDULE

A. Concrete shall be finished as follows unless indicated otherwise:

1. Building Interior:

Floors intended as walking surfaces or to receive a floor covering, bases, and curbs:	Troweled finish*.
Other slabs intended to receive roofing, water-proofing membrane or sand bed terrazzo:	Float finish*.
Exposed formed surfaces:	Smooth-rubbed finish*.
Other formed surfaces:	Smooth-rubbed finish*.

2. Building Exterior:

Slabs, drives, and walks:	Broom finish*.
Exposed formed surfaces:	Grout-cleaned finish to 6-in below grade*.
Other formed surfaces:	Smooth form finish*.

3. Pedestrian Ramps and Exterior Stairs: Non-slip finish*.

4. Tanks and Other Liquid Retaining Structures:

Slabs:	Float finish*.
Interior formed surfaces to 6-inches below low water level:	Grout-cleaned finish*.
Interior formed surfaces lower than 6-inches below low water level:	Smooth form finish *.
Exterior formed surfaces:	Grout-cleaned finish to 6-in below grade*.
Other formed surfaces:	Rough form finish*.

* Concrete surface finish shall be coordinated and acceptable surface finishes to be applied to concrete.

3.15 ELECTRICAL CONDUITS AND LIQUID PIPE EMBEDMENTS

A. Prior to placing concrete with embedded conduits and pipes the contractor shall submit a layout plan drawing that includes the locations, quantity and size of these items. The

layout plan shall be submitted to the Engineer at least 14 days prior to placement for approval.

B. Conduits, pipes and sleeves passing through slabs, walls or beams shall not impair significantly the strength of construction. Conduits and pipes shall not be embedded in columns or beams without the approval of the engineer.

C. Conduits and pipes embedded within slabs and walls shall not be larger in outside dimension than one-third the overall thickness of the slab or wall that they are embedded in.

D. Conduits and pipes embedded within slabs and walls shall not be spaced closer than 3 diameters on center.

E. Concrete cover over conduits, pipes and fittings shall not be less than 2 inches.

3.16 HOUSEKEEPING PADS

A. Unreinforced concrete pads shall be installed under all floor-mounted items such as motor control centers, electrical panels, control panels, transformers, and HVAC equipment that do not produce vibration. The pads shall be4 inches high with chamfered edges and a troweled finish, unless noted otherwise on the drawings.

3.17 EQUIPMENT PADS

A. Reinforced concrete pads shall be installed under all generators, pumps, motors, blowers, drives or other pieces of equipment with internal moving parts that may produce vibration. The pads shall be a minimum of 4 inches high. Refer to standard pad details given on the drawings.

PART 4 SPECIAL PROVISIONS

4.01 CRYSTALLINE WATERPROOFING ADDITIVE

A. Contractor to provide crystalline waterproofing additive to cast-in-place concrete where indicated on the drawings or as specified. The crystalline waterproofing material shall be Xypex Admix C-500 NF or Penetron Admix. Dosage rate shall be 1.0% (minimum) of weight of cementitious material.

B. Concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete. The system shall cause the concrete to become sealed against the penetration of liquids from any direction and shall protect the concrete from deterioration due to harsh environmental conditions.

C. Admix must be added to concrete mix at time of batching. The actual dosage in the mix design shall be certified at the time of application.

D. Manufacturer shall coordinate with the concrete batch facility and other admixture suppliers to ensure compatibility with the concrete mix design, other admixtures and

concrete properties. The addition of the crystalline water proofing shall not reduce the concrete strength or compromise the ASTM specifications or other quality standards governing the concrete mix.

E. Concrete containing crystalline waterproofing admixture shall be moist cured in accordance with ACI Reference 308, “Standard Practice for Curing Concrete”.

END OF SECTION

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SECTION 03310
GROUT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes non-shrink cementitious and epoxy grouts.

B. Masonry grout and bonding grout are specified in other Sections.

C. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Contractor shall indicate variances from requirements of Contract Documents.

b. Product literature.

c. Material certifications of ASTM standard and grade.

d. Laboratory test reports for grout compressive strength tests.

2. Information for the Record:

a. Manufacturer's mixing, placing, and curing instructions.

1.03 PRODUCT HANDLING

A. Environmental limitations specified by manufacturer shall be observed. Heated enclosures shall be provided as required.

PART 2 PRODUCTS

2.01 NON-SHRINK GROUT

A. Grout shall be prepackaged, nonmetallic, noncorrosive, non-staining cementitious grout. Grout shall remain volume stable in both dry and wet conditions and provide a minimum of 95% effective bearing area.

B. Grout shall conform to ASTM C1107 Grade C when tested at fluid consistency of 25 seconds or more per ASTM C939 at temperature extremes of 45 degrees F and 90 degrees F and a working time of 30 minutes. Metallic grouts are prohibited.

C. Non-shrink property shall not be based on any gas generating additives such as aluminum oxide.

D. Minimum compressive strength: 1 day 3500 psi
(2-inch cube cured at 70 degrees F) 7 day 5500 psi
28 day 7500 psi

E. Non-shrink grout shall be Five Star "Fluid Grout 100", Master Builders "Masterflow 928 Grout", or equal.

2.02 EPOXY GROUT

A. Grout shall be non-shrink prepackaged epoxy grout which will achieve a minimum effective bearing area of 95%.

B. Max unrestrained linear shrinkage: 0.0005 inch per inch (ASTM C531)
Max coefficient of expansion: 27 x 10-6 inch/inch/degree F
Minimum compressive strength: 7 day 11,500 psi
(2-inch cube cured at 70 degrees F)

C. Epoxy grout shall be Five Star "HP Epoxy Grout", Master Builders "Masterflow 648", or equal.

2.03 MIXING

A. Grout shall be mixed with mechanical mixers in accordance with manufacturer's written instructions. A mortar mixer with moving blades shall be used to thoroughly blend the potable water into the mix.

B. Water used to mix non-shrink cementitious grout shall be potable. Water shall be added in just sufficient quantity to obtain desired consistency, but shall not exceed manufacturer's maximum recommendations. Grout shall be used in as stiff a consistency as possible. Grout shall not be re-tempered by addition of water. Grout manufacturer shall be consulted when additional flowability is required.

C. Materials other than those supplied by grout manufacturer shall not be added to grout.

D. Cementitious grout shall be mixed close to its placement site, and transportation and placement time shall be limited to less than 15 minutes. Mixed grout temperature shall be held between 45 degrees F and 70 degrees F using ice or hot water as required.

E. Epoxy Grouts - ingredients are prepackaged and pre-measured and shall be completely mixed in accordance with the manufacturer's instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Concrete to receive grout shall have minimum compressive strength of 3000 psi. New concrete shall be cured as specified prior to placing grout.

B. Defective or deteriorated concrete shall be removed. Laitance, grease, oil, and other substances which prevent bond shall be removed. Concrete shall be roughened by chipping, sand-blasting, or other mechanical means to assure the bond of the grout to the existing concrete.

C. Oil, grease, and dirt shall be removed from the underside of base plates and bearing plates. Air relief holes shall be provided in base plates to eliminate air entrapment.

D. Concrete to receive non-shrink cementitious grout shall be saturated with water for 24 hours prior to grout placement. Concrete to receive epoxy grout shall be dry.

E. Forms shall be constructed of coated wood or steel. Forms shall be constructed and anchored to resist hydraulic head of grout and shall be leak-tight when fluid grouts are used.

F. Unless otherwise specified, non-shrink, cementitious grout shall be used under column and equipment bases. Equipment such as stamping machines, compressors, crushers, etc., involving high impact or vibration, and applications requiring chemical resistance, shall use non-shrink epoxy grouts.

G. When placing more than 5.0 cubic feet of epoxy grout, contact the manufacturer for recommendations.

3.02 PLACING

A. Grout shall be placed in accordance with manufacturer’s instructions.

B. Grout shall be placed from only one side of form to avoid air entrapment. Grout shall be placed in a continuous operation to avoid cold joints under base plates. Spaces and cavities below top of baseplate shall be completely filled without voids or air pockets.

C. Grout shall be rodded or vibrated to remove entrapped air.

D. Grout exposed to view shall be finished smooth after initial set.

E. Unless otherwise shown, cementitious grouts shall be placed in minimum 1 inch thickness and epoxy grouts shall be placed in minimum 2-inch thickness. Manufacturer’s recommendations for minimum thicknesses required for specific situations shall override these specified minimum values.

F. If the grout extends up the side of a baseplate, it must be cut back to the lower level of the baseplate to avoid cracking of the grout due to possible movement of the baseplate caused by temperature changes, vibrations, etc.

3.03 CURING

A. Grout shall be cured and protected in accordance with manufacturer's instructions.

B. Non-shrink cementitious grout shall be wet cured for minimum of 7 days.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 03710
CONCRETE RESTORATION

PART 1 GENERAL

1.01 SCOPE

A. This Section covers the furnishing of all labor, equipment, and materials required to repair, rehabilitate, or reconstruct spalled, deteriorated or structurally damaged concrete. Depth of repairs shall be adequate to restore concrete member or slab to original dimensions after proper preparation to sound concrete.

B. Additional product requirements are specified in Section 01350 and Section 03300.

1.02 SUBMITTALS

A. Submittals shall be in accordance with requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. Concrete mix design.

   b. Product literature for proprietary patching materials, admixtures, bonding adhesive, and anchors.

2. Information for the Record:

   a. Material certifications.

   b. Contractor qualification certification.

   c. Product manufacturer's surface preparation, mixing, application, and curing instructions.

   d. Cold weather and hot weather procedures.

   e. Test reports.

1.03 REFERENCES

A. "Guide to Repair of Concrete" - ACI 546R-96.

B. "Specifications for Repairing Concrete with Epoxy Mortars" - ACI 503.4-92.

1.04 PREBID INSPECTION

A. The repair areas shown on the Drawings or specified for repair are based on a general survey. The Contractor shall visit the Site prior to Bid submittal to determine the extent of the required repairs.

1.05 QUALITY ASSURANCE

A. Pre-installation Conference - Before beginning restoration work, Contractor shall hold job site meeting to review detailed requirements and procedures for concrete restoration. Representatives of Contractor, testing laboratory, patching material supplier, and Engineer shall be in attendance.

B. Contractor Qualifications - Contractor shall have experience and proficiency specific to the repair type and shall be approved by the manufacturer of repair material. Certification from manufacturer shall be submitted.

1.06 ENVIRONMENTAL CONDITIONS

A. Unless adequate protection is provided, patches shall not be placed during rain, sleet, or snow, or when inclement weather is imminent. When temperature is less than 40 degrees F or when the temperature is expected to fall below 40 degrees F during the curing period, cold weather procedures shall apply. Patching material shall not be applied to frozen surfaces.

B. When conditions of material temperature, air temperature, wind velocity, and relative humidity combine to cause plastic shrinkage cracking, flash set, or otherwise impair the quality of patch, hot weather procedures shall apply.

C. All materials used for the repair work must be VOC compliant.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Product shall be delivered in original, unopened containers with manufacturer's name, labels, product identification, and batch numbers clearly discernible.

B. Materials shall be stored and conditioned in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.01 POLYMER-MODIFIED MORTAR - For repairs 1/8 inch to 3 inch deep.

A. Patching mortars shall be latex-modified cementitious mortar. Material shall be thermally compatible with base substrate and shall not produce vapor barrier.

B. 28-day compressive strength (ASTM C109) – 6,000 psi minimum

28-day flexural strength (ASTM C348) – 1,500 psi minimum

28-day bond strength (ASTM C882) – 2,000 psi minimum

C. Material shall not contain asbestos, chlorides, nitrates, added gypsum, added lime, or high aluminum cements and shall be suitable for wet environments.

D. Material shall be supplied in factory proportioned unit.

E. Color of cured material shall be concrete-gray.

F. Coefficient of thermal expansion of patching mortar shall be compatible with coefficient of thermal expansion of concrete.

G. Schedule:

1. Horizontal Repairs 1/8-inch to 1-inch Deep - Material shall be trowel grade. Sika Corporation “SikaTop 122 Plus” neat, or equal.

2. Horizontal Repairs 1-inch to 3-inches Deep – Material shall be polymer-modified, cementitious, screed mortar. Sika Corporation “SikaTop 111 Plus” extended with 3/8-inch aggregate, or equal.

3. Unformed Vertical/Overhead Repairs 1/8-inch to 3-inches Deep (Lifts not to exceed 1-1/2 inches) – Material shall be fast-setting and non-sagging. Sika Corporation “SikaTop 123 Plus”, or equal.

4. Formed Vertical/Overhead Repairs 1/8-inch to 1-inch Deep – Material shall be fast-setting and free-flowing mortar suitable for pouring or pumping. Sika Corporation “SikaTop 111 Plus” neat, or equal.

5. Formed Vertical/Overhead Repairs 1-inch to 3-inches Deep – Material shall be fast-setting and free-flowing mortar suitable for pouring or pumping. Sika Corporation “SikaTop 111 Plus” extended with 3/8-inch aggregate, or equal.

H. Mixing:

1. Materials shall be mixed in accordance with manufacturer’s written instructions.

2. Material shall be mechanically mixed to uniform consistency, but shall not be overmixed.

3. Aggregate may be added for thick patches when approved by manufacturer. Quantity, type, size, and gradation of aggregate shall be in accordance with manufacturer’s written instructions.

4. The temperature of latex modified mortar as placed shall be between 55 degrees F and 85 degrees F.

2.02 LOW-SLUMP CONCRETE - For repairs greater than 3 inches deep, or repairs over large areas.

A. Materials:

1. Cement - ASTM C150 Type I/II

2. Aggregate - ASTM C33, Class 4S.

3. Fly Ash - ASTM C618, Class F.

4. Ground Granulated Blast Furnace (GGBF), ASTM C989 Grade 100 or 120.

5. Admixtures:

a. Air Entraining - ASTM C260

b. Only admixtures certified by their manufacturer as chloride ion-free shall be used.

6. Water shall conform to ASTM C94.

B. Mix Proportions:

1. Concrete shall be proportioned to maximize durability and to minimize shrinkage.

2. Water/Cement Ratio - 0.40 maximum, minimum 28-days compressive strength equals 5,000 psi.

3. Slump - Horizontal patches - 1-inch maximum.

4. Formed vertical/overhead patches - 3-inch maximum.

5. Concrete exposed to freezing while in moist condition shall be air entrained for severe exposure.

6. Nominal maximum aggregate size shall not be more than 1/3 of patch depth, nor 3/4 of minimum clear spacing between reinforcing bars.

C. Mixing - Concrete shall be mixed in batch mixer capable of thoroughly combining aggregates, cement, and water. Concrete shall be mixed until uniform consistency is obtained.

2.03 BONDING ADHESIVE

A. Bonding adhesive shall be polyamine epoxy/portland cement adhesive and shall not form vapor barrier.

B. Bonding adhesive shall be Sika Corporation “Armatec 110”, or equal.

2.04 REINFORCEMENT

A. Reinforcing bars shall be grade 60 deformed bars conforming to ASTM A615 or ASTM A616 including supplementary requirements S1.

2.05 ANCHORS

A. Anchors shall be 1/4-inch diameter T-shaped rods of 304 stainless steel. Hohmann & Barnard, Inc. “#423 Stone Anchors” or equal.

PART 3 EXECUTION

3.01 TEMPORARY SHORING

A. Temporary shoring shall be installed when shown or when otherwise required to prevent deflection, cracking, and other damage to structure. Shoring shall be

maintained in-place until patches have gained sufficient strength. Design of temporary shoring shall be responsibility of Contractor.

B. Construction loads shall be minimized on members requiring patching so that structural damage is prevented.

C. Engineer shall be notified immediately when:

1. Patch depth exceeds 15% of least dimension of column or beam.

2. Patch depth exceeds 15% of thickness of wall or slab and patch width exceeds 4 times wall or slab thickness.

3.02 FORMWORK

A. Formwork shall comply with pertinent provisions of “Guide to Formwork for Concrete (ACI 347R),” American Concrete Institute, and shall comply with requirements of governmental agencies having jurisdiction.

B. Forms shall be provided on under or back side of full-depth patches and shall be provided on face of overhead or vertical patches in excess of 4-feet wide.

C. Forms shall be mortar-tight and shall be clean. Release agent shall be applied to forms before they are positioned. Prepared concrete surface shall not be contaminated with form release agent.

D. Forms may be removed as soon as patch has hardened sufficiently to resist damage from removal operations.

3.03 PREPARATION

A. Perimeter:

1. Perimeter of patch shall be approximately rectangular and shall be within limits determined by Resident Project Representative. Resident Project Representative shall be notified when unsound concrete is discovered beyond predesignated limits of patch.

2. Perimeter of patch shall be undercut slightly to a minimum depth of 1/2 inch, but reinforcement shall not be cut. Saw kerf shall not extend past perimeter of patch. Avoid feather edges.

B. Selective Removal and Surface Preparation:

1. Loose and deteriorated concrete shall be removed to sound substrate. Depth of patch shall be approximately uniform.

2. Where more than half of diameter of reinforcing bar is exposed or if bar with active corrosion is encountered, concrete behind bar shall be chipped out to depth of 3 times maximum aggregate size, but not less than 3/4 inch.

3. Concrete substrate shall be chipped to surface profile of 1/8 inch with new-fractured aggregate surface.

4. Chipping hammers shall be hand-held type weighing not more than 30 pounds and shall use gad point. Chisel points are prohibited. Use of scabbler is not permitted. Scarifier shall be of type which cuts on up-stroke.

C. Contaminated surfaces shall be detergent washed or steam cleaned in accordance with ASTM D4258. Water used in detergent washing shall be approximately 180 degrees F.

D. Surface shall be sweep blasted with coarse, hard, and angular abrasive. Abrasive shall be Black Beauty High Grade Sand. Air stream shall be free of oil.

E. Acid etching is not permitted.

F. Cracks in substrate in area of patch shall be repaired as directed by Engineer.

G. Control and expansion joints in existing structure shall be extended through patch.

H. Immediately prior to applying patch, surface shall be vacuum cleaned with heavy-duty industrial vacuum.

I. Adequacy of surface preparation and soundness of concrete shall be demonstrated by performing pull-off test in accordance with ASTM D4541. Minimum acceptable pull-off strength shall be 150 psi. One pull-off test shall be performed for each 200 square feet, or fraction thereof, of patch.

3.04 REINFORCEMENT

A. Reinforcement with active corrosion shall be uncovered to point where bar is well bonded to concrete.

B. Corrosion product shall be removed by abrasive blasting.

C. Engineer shall be notified if any one bar has lost more than 15% of its original cross-section. Engineer will specify method of repairing corroded reinforcement.

3.05 ANCHORS

A. Anchors shall be placed where depth of patch exceeds 3 inches or where shown on drawings. Anchors shall be spaced at 12-inch center to center, each way, unless noted otherwise. Anchors shall have 1-1/2-inch minimum concrete cover.

B. Anchors shall be epoxied 3 inches into existing concrete. Epoxy shall be Hilti HIT Re-500 or equal.

3.06 PATCHING

A. Substrate shall be saturated for one hour prior to patching. At time of patching, substrate shall be saturated surface dry (SSD), with no standing water.

B. Patches more than 3 inches deep shall be made with low-slump concrete. Patches less than 3 inches deep shall be made with latex-modified patching mortar, unless noted otherwise.

C. Bonding adhesive shall be applied to substrate when patch is made with low-slump concrete. Bonding adhesive shall be applied in accordance with manufacturer's recommendations.

D. Unformed Patch:

1. Mortar shall be scrubbed into substrate and previous lifts to fill pores and voids.

2. While scrub coat is still plastic, patching material shall be pressed onto substrate with trowel. Patching shall start at edges of patch and work towards center.

3. Material shall be compacted into corners and around reinforcement and other embedments by tamping and internal vibration.

4. Vertical/overhead patching shall be performed in lifts approximately 1-1/2 inches thick. Surface of each lift shall be intentionally roughened. Preceding lift shall reach final set before additional material is applied.

E. Formed Patch:

1. Material shall be pumped or poured into form in manner to prevent air entrapment.

2. Form shall be vibrated during placement to achieve flow and compaction. Internal vibration shall be used in thick patches when practicable.

F. Patch shall be finished to match surrounding concrete.

3.07 CURING

A. Latex-modified material shall be cured in accordance with manufacturer's written instructions.

B. Low-slump concrete shall be cured minimum of 7-days. Concrete shall be cured by wet burlap covered with plastic sheeting conforming to ASTM C171 unless specified otherwise. Burlap shall be dampened during curing period as required.

3.08 COLD WEATHER

A. Snow, ice, and frost shall be removed from reinforcement and substrate against which patch is to be placed. Patch shall not be applied to frozen substrate.

B. Temperature of patching material shall be within 50 degrees and 85 degrees F, but shall not vary more than 10 degrees F from substrate temperature.

C. Patch shall be protected by heated enclosure for minimum of 3 days, beginning immediately after placement. Air temperature within enclosure shall be 50 degrees - 70 degrees F.

D. Low-slump Concrete shall not be cured by wet curing methods.

3.09 HOT WEATHER

A. Substrate shall be cooled by saturating with water two-hours prior to patching. Temperature of patching material shall not vary more than 10 degrees F from substrate temperature.

B. Wind and sun screens shall be erected during and after patching to prevent plastic shrinkage cracking.

C. Latex-modified patching material and low-slump concrete shall be cured by wet curing method as specified.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, detailing, fabricating, shop coating, delivering, erecting and/or installing structural steel as shown on Drawings and specified in this Section. Structural steel generally includes:

1. Roof, floor and wall framing elements of standard structural shapes or built-up sections.
2. Base, cap and bearing plates.
3. Beams, girders, purlins, girts, columns and posts.
4. Bracing.
5. Hangers, struts, tie rods, and sag rods.
6. Anchor bolts for structural steel.
7. Connecting materials including shear connectors.
8. Trusses.
9. Design engineering where specifically called for by this section.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. Shop Drawings shall indicate:
        1) Materials of construction.
        2) Plan layouts, elevations and sections.
        3) Connection details.
        4) AWS weld designations and welding procedure.
        5) Surface preparation and shop coatings.
        6) Accessory materials.
        7) Required field measurements.

8) Material certification verifying conformance to applicable specifications of ASTM serial designation.

b. Product data for each type of product specified.

c. Seal of professional structural engineer registered in the state where the Project resides on items where a design engineer is specified. Provide signed and sealed drawings and calculations, when specified.

2. Information for the Record:

a. Welder qualification certificates.

b. Inspection reports and test certificates.

1.03 QUALITY ASSURANCE

A. Standards - Structural steel shall be designed, fabricated, and installed in accordance with following standards.

1. "Structural Welding Codes", American Welding Society.

2. "Specification For Structural Steel Building" as approved by American Institute of Steel Construction.

3. "Code of Standard Practice for Steel Buildings and Bridges", as approved by American Institute of Steel Construction.

4. "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation.

5. "Specification for the Design of Cold-Formed Steel Structural Members", American Iron & Steel Institute.

6. "Surface Preparation Specification", Steel Structuring Painting Council.

1.04 PERFORMANCE REQUIREMENTS

A. Contractor is responsible for employing design engineer for the items listed by this Article. Design engineer shall follow the performance requirements provided in the pertinent parts of this Section:

1. Simply end beam connections to steel.

2. Simply end brace connections to steel.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall use special care in unloading, handling, and erecting steel to avoid bending, twisting, or otherwise distorting the members. Material shall be handled in such a way to minimize damage to shop coatings.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports.

C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

D. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed in the same day shall be removed from storage. Clean and re-lubricate bolts and nuts that become rusty before use.

1.06 PROJECT CONDITIONS

A. Prior to fabrication, Contractor shall field measure structures when required for proper fit.

PART 2 PRODUCTS

2.01 MATERIALS

A. Wide Flange Shapes(W) - ASTM A992.

B. Other Rolled Shapes, Plate, and Bar - ASTM A36 or ASTM A572 Grade 50 as indicated on the Drawings. Where no indication is given, use ASTM A-36.

C. Hollow Structural Sections (HHS), tube and pipe - ASTM A500 Grade B.

D. Pipe - ASTM A53, type E or S, grade B.

E. Shear connectors, where required, shall be stud type and shall conform to ASTM A108 with minimum tensile strength = 60 ksi, and minimum yield strength = 50 ksi.

F. Galvanizing - ASTM A123.

2.02 ASSEMBLY AND ERECTION FASTENERS

A. Bolts and Nuts:

1. High strength bolts - ASTM A325, Type 1 or ASTM A490, Type 1. When no indication is given, ASTM A325 shall be used.

2. High strength and alloy bolts shall bear a distinctive head marking identifying bolt grade.

3. Nuts shall be heavy hex type ASTM A563 Grade C for plain A325 high strength bolts and DH for galvanized bolts. For 490 bolts, heavy hex nuts conforming to ASTM A194 Grade 2H, or ASTM A563 Grade DH or DH3, shall be used.

B. Washers - ASTM F436 plain with plain bolts and galvanized with galvanized bolts

C. Nuts and washers of same finish and material as bolts shall be furnished.

2.03 ANCHOR RODS

A. Bolt and Stud Material:

1. Carbon Steel - ASTM F1554, Grade 55.
2. Threaded Rods - ASTM A36.
3. Stainless Steel - ASTM F593, AISI Type 304.
4. Pipe Sleeves - Steel - ASTM A501, ASTM A120, ASTM A53.
5. Anchor Rod Sleeves - Plastic - Wilson Ankor Shield or equal.

B. Nuts and washers of same finish and material as bolts shall be furnished.

C. Sufficient thread length shall be provided to permit installation of nut on both sides of concrete form or template. Anchor length shall be sufficient to include 1-1/2-inch grout space beneath column base plates, or as shown on Drawings.

D. Anchor embedment and hook dimension shall be as shown on Drawings.

2.04 WELDING

A. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

B. Welding shall be performed using only prequalified joint details in accordance with AWS Structural Welding Code.

C. Welding electrode shall conform to the requirements of AWS D1.1 and Table 3.1 therein.

D. Butt joints shall be made with full penetration welds. Minimum size of fillet welds shall be 3/16 inch, except as otherwise required.

E. Rough welds shall be ground to remove sharp edges, undercuts, pinholes and other irregularities. Overgrinding, which would result in decreasing metal thickness or integrity of weld beyond limits of good welding practice, shall be avoided.

F. Details and sizes of fillet, plug, and slot welds shall conform to provisions stated in Section 2 of AWS D1.1.

G. All weld connections shall comply with AWS D1.1 for procedures, appearance, and quality of welds and methods used in correcting welding work.

2.05 SIMPLE END BEAM AND BRACECONNECTIONS

A. Design engineer shall design connections and provide signed and sealed calculations for connections that are not explicitly detailed on the Drawings. For standard double angle connections designed by steel construction manual tables, a signed and sealed certified letter will be accepted in lieu of calculations.

B. Simple connections are metal beam and brace connections that resist bearing, shear and axial forces and are not required to resist moment forces.

C. Shop connections may be welded or bolted. Field connections shall be bolted unless shown otherwise. Beam connections shall have a minimum of two rows of bolts and connecting angles or plates shall be at least half the depth of the connected beam.

D. Bolted connections shall be designed using 3/4-inch ASTM A325 bolts in snug-tightened condition, unless noted otherwise. Bolt thread condition shall be Type N or Type X. Where detailed connections are not shown and end reactions are not indicated on the Drawings, member connections shall be designed to support the minimum load of 50% of the total uniform load for the member span as given by the "Maximum Total Uniform load, kips" table of the latest edition of the Steel Construction Manual as published by AISC. Use 50 ksi steel ASD tables for W-sections, WT-Sections, M-sections and S-sections. Use 36 ksi steel ASD tables for C-sections, MC-sections and Angles. The connections shall be designed for greater loads when these loads are indicted on the drawings

E. Connection design shall take into account block-shear-tension-rupture, block-shear-shear-yielding, block-shear-shear-rupture, bolt hole bearing strength and flange coping.

F. Connection designs shall take into account pre-tensioned and slip critical conditions when indicated on the drawings.

G. Provide pretensioned or slip-critical bolted joint connections where specified or indicated on the Drawings.

2.06 OTHER CONNECTIONS

A. Other connections are connections that are not simple. These include, but not limited to, moment, column base plate, connections to materials other than metal and explicitly detailed connections.

B. Bolted connections shall be designed using 3/4-inch ASTM A325 bolts in Snug-Tightened condition, unless noted otherwise. Bolt thread condition shall be Type N or Type X

C. Fabricator shall provide bolt spacing, hole sizes, and hole edge distances per the appropriate standard given herein when not provided on the Drawings.

D. Provide Pretensioned or Slip-Critical bolted joint connections where specified or indicated on the Drawings.

2.07 FABRICATION

A. Structural steel shall be fabricated as shown on approved Shop Drawings. Work shall be straight and true, free from warps, deformations, unauthorized splices, and unauthorized bends. The as-fabricated tolerances of exposed members shall not exceed one-half of the standard camber and sweep tolerances specified in ASTM A6.

B. Structural steel shall be fabricated and assembled in the shop to the greatest extent practicable. Members shall be fabricated to proper length, so that use of fillers and

shims is avoided. Minimum thickness for all gusset plates, stiffeners, etc. shall be 3/8-inch, unless shown otherwise.

C. Unless shown otherwise, bracing connections shall be detailed such that the gravity axis of the connected members intersects at a common Work point.

D. Sharp edges shall be removed by power grinding. Projecting corners shall be clipped at a 45-degree angle.

E. Holes and other provisions for field connections shall be accurately located. Connections shall be shop checked for proper fit. Connection materials shall be match-marked when required for proper erection.

F. Provide holes for securing other Work to structural steel and for passage of other Work through structural steel as shown on Drawings.

G. Holes produced by flame cutting shall be ground smooth.

H. Surfaces to be coated shall have gouges, handling marks, deep scratches, metal stamp marks, slivered steel and other surface flaws repaired. Surface flaws shall be repaired by welding and grinding as required.

I. For bolted connections, at least one full thread shall project beyond the nut when tightened.

2.08 SHOP COATING

A. Structural steel wholly embedded in concrete or masonry and with a minimum of 2 inches of concrete cover shall be abrasive blasted in accordance with SSPC SP-6, but shall not be coated. Exposed portions of partially embedded structural steel shall be shop coated to a point 4 inches below the concrete surface.

B. Galvanized structural steel shall be hot dip galvanized after fabrication in conformance with ASTM A123. Threaded parts and hardware shall be galvanized in conformance with ASTM A153 or zinc plated in conformance with ASTM B695. The galvanized faying surfaces of slip-critical bolted connections shall be Class C.

C. Painting - Unless specified otherwise, all structural steel, unless galvanized, shall be shop primed in accordance with the requirements of Section 09900.

1. Where bolted connections are indicated to be slip-critical, primer shall be minimum of Class A when tested in accordance with “Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints” as adopted by Research Council on Structural Connections. Manufacturer’s certification shall include a certified copy of test report.

2. Surfaces which will be inaccessible for field painting after installation shall receive two coats of primer.

D. Contractor shall ensure primer is compatible with specified field coatings.

PART 3 EXECUTION

3.01 ERECTION

A. Structural steel shall be assembled accurately to the lines and elevations shown on Drawings. Erection of structural steel shall conform to AISC standards.

B. Columns shall be leveled with leveling nuts. Leveling plates are not permitted. After column is leveled and plumbed, the base plate shall be set in non-shrink grout in accordance with Section 03310.

C. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not permitted. Where holes do not match, holes may be reamed slightly using a tapered reamer. Enlarging holes by electric arc or gas torch burning is prohibited.

D. Faying surfaces of connections shall be free of loose scale, dirt, burrs, oil, grease, and other contaminants.

E. Altering structural steel in field by electric arc or gas torch burning is prohibited.

F. Galvanized steel shall not be field bent, cut, welded, or otherwise altered. Material so altered will be considered defective.

G. Install and connect all permanent bracing concurrently with the main structural steel erection before construction loads are applied.

H. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

I. Tighten anchor rods 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.

3.02 ASSEMBLY AND ERECTION FASTENER INSTALLATION

A. Hardened washers shall be installed under turned element of bolts. Beveled washers shall be installed when bearing surface of the bolted parts have a slope of 1:20 or greater with respect to the bolt axis.

B. Fastener threads which have been contaminated with dirt shall be cleaned and lubricated.

C. Bolts shall be tightened progressing systematically from stiffest part of connection toward free edges.

D. Bolted connections shall be Snug-Tightened-Joints, unless specified or noted otherwise.

E. Slip-critical and pretensioned joint connection bolts shall be pre-tensioned to the value given by Table 8.1 of Section 16.2 of the Specifications for Structural Joints Using ASTM A325 or A490 Bolts as prepared by RCSC.

F. Bolts in slip-critical and pretensioned joint connections shall be tightened by one of the following methods: “Turn-of-Nut” with match-marking, Twist-Off-Type Tension-Control Bolt Pretensioning or Direct-Tension-Indicator Pretensioning in accordance with “Specification for Structural Joints Using ASTM A325 or A490 Bolts” as approved by the Research Council on Structural Connections. The Turn-of-Nut Method will not be approved without match-marking of the nut and protruding end of the bolt after snug-tightening.

G. All connected steel plies shall be free of dirt, oil, lacquer and burrs, and shall be in firm contact prior to bolting. The faying surface shall be uncoated, coated or galvanized in accordance with Section 3 of the Specification for Structural Joints Using ASTM A325 or A490 Bolts as approved by the RCSC. When connection is designated as slip-critical uncoated and coated faying surfaces shall be Class A, and galvanized faying surfaces shall be Class C.

H. Bolts shall not be reused once tightened beyond snug-tight.

3.03 FASTENER AND ANCHOR SCHEDULE

A. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

1. Stainless steel and aluminum structures shall have stainless steel fasteners.
2. Galvanized structural steel structures shall have galvanized or zinc-plated fasteners.
3. Other structural steel - anchors and fasteners shall be uncoated.

3.04 FIELD WELDING

A. Field welding when shown, specified, or otherwise permitted by Engineer shall be performed in strict accordance with the requirements specified for shop welding.

B. Areas adjacent to field welds shall not be shop primed. Primer shall be applied after welding.

3.05 COATING REPAIR

A. Field welds, bolts, and other areas where shop coat is discontinuous or has been damaged during erection, shall be cleaned in accordance with SSPC Standard SP3 and shall receive one coat of prime paint to match the original coating.

B. Repair of minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer’s discretion.

3.06 DISSIMILAR MATERIALS

A. Where dissimilar materials come into contact, use neoprene washers, spacers, gaskets or other Engineer approved materials between them to provide insulation against electrolytic action.

3.07 QUALITY CONTROL INSPECTION AND TESTING

A. The Contractor shall employ a laboratory to perform the following inspections and testing verifications:

1. At the start of Work the inspector at the Site of the project shall:

   a. Verify that the material identification markings for structural members, high strength bolts, nuts and washers correspond to the appropriate ASTM designations.

   b. Verify that on-site welders designated by the Contractor are certified to perform welding

   c. Verify that the proper welding electrodes, equipment and procedures are being utilized.

   d. Verify the calibration of the tension calibrator and observe the pre-installation testing pretensioned and of slip-critical bolts. The pre-installation verification shall be performed according to Section 7, to obtain a pretension greater than 1.05 times that specified in Table 8.1 of the Specification for Structural Joints Using ASTM A325 or A490 bolts as approved by RCSC. This verification shall be performed for each building of the project and for every six months of any one building's construction.

2. Periodic inspections:

   a. Verify that the material identification markings for structural members correspond to the appropriate ASTM designations. This verification shall be performed for each building of the project and for every six months of any one building's construction.

   b. Verify that material identification markings for high strength bolts, nuts and washers correspond to the appropriate ASTM designations. This verification shall be performed every 400 bolts.

   c. Verify that connection details for beam, columns and braces comply with construction drawings. Inspect every 10th connection joint or portion thereof.

   d. Observe that snug-tightened-joints are being properly connected per Section 9 of the Specification for Structural Joints Using ASTM A325 or A490 bolts as approved by RCSC. Verify connection plies are free of burrs and are in firm contact with each other. Verify connections have

the correct number of bolts with the correct type of nuts and washers. Inspect every 10th connection joint or portion thereof.

e. Inspect the surface condition and verify the appropriate Class of the faying surface of slip-critical-joints. Inspect every 10th connection joint or portion thereof.

f. Observe that pretensioned and slip-critical-joints bolts are being properly installed per the requirements of Section 9 of the Specification for Structural Joints Using ASTM A325 or A490 bolts as approved by RCSC. Inspect every 10th connection joint or portion thereof.

g. Verify that the proper welding electrodes, equipment and procedures are being utilized. Perform this verification once each month of construction.

h. Visually inspect all welded connections using AWS D1.1, Table 6.1 acceptance criteria, except as modified by Section J2 of the ANSI/AISC 360-5 Specification for Structural Steel Buildings, prior to project completion. Observe the welding work in progress once a week of the following types:

1) Single-pass fillet welds not exceeding 5/16 inch in size.

2) Welding of stairs and handrails.

3. Continuous Inspections:

a. Visually inspect all welded connections using AWS D1.1, Table 6.1 acceptance criteria, except as modified by Section J2 of the ANSI/AISC 360-5 Specification for Structural Steel Buildings. Continuously observe the welding work in progress of the following types:

1) Complete and partial joint penetration grove welds.

2) Multi-pass fillet welds.

3) Single-pass fillet welds greater than 5/16 inch in size.

4) Plug and slot welds.

5) Welds of reinforcing bars to structural.

B. If inspections determine that a specific item does not comply with the Contract Documents the contractor shall make corrections until the item passes the inspection. The cost of corrections and additional inspections shall be paid for by the Contractor.

PART 4 SPECIAL PROVISIONS

4.01 CRITERIA FOR BASE METAL REPAIR OF STRUCTURAL STEEL

A. This criteria shall cover damage induced to existing structural steel during or subsequent to installation of steel. Injurious imperfections, such as voids and gouges, shall herein be

defined as a base metal discontinuity which results in a reduction of the cross-sectional area of a member, and which exceeds the limiting depths specified below for various thicknesses of material. Except for discontinuities of 1/32 inch and less in depth which are acceptable without any repair, base metal shall be conditioned for the removal of discontinuities by chipping and/or grinding. Weld repair is not required, provided the excavated area is well faired without abrupt changes in contour and the depression does not extend below the rolled surface by more than:

1. 1/32 inch for material less than 3/8 inch thick.
2. 1/16 inch for material 3/8 inch to 2 inches (inclusive) thick.
3. 1/8 inch for material over 2 inches thick.

B. Voids and gouges greater in depth than the limits given above and all cracks and tears are considered injurious and shall be weld repaired using the methods given below; however, in no case shall the depth of excavations exceed 30% of the base metal thickness without written approval of the Engineers. Prior to welding, the excavations shall be visually (and for cracks and tears, magnetic particle or liquid penetrant) examined to insure complete removal of defects. Excavations shall have a minimum root radius of 1/8 inch, a minimum included angle of 45 degrees on the cross section, and shall be gradually tapered up to the base metal surface at the ends. Repair welding shall be performed in accordance with the parameters of an AWS D1.1 qualified backing bar weld procedure. Completed surfaces of all repair welds shall be visually examined to the acceptance criteria of AWS D1.1 Section 8.15.

4.02 CRITERIA FOR REPAIR OF WELD DEFECTS AND DAMAGED WELDS

A. Repair of damage or discontinuities in previously completed welds shall be in accordance with the criteria outlined below. In conjunction with the requirements outlined in weld procedure W200A, defects in welds shall be removed by chipping, arc-gouging, or grinding until sound metal is reached. Removal of indications such as cracks or tears, shall be verified by Magnetic Particle or Liquid Penetrant examination. Removal of other indications and/or damaged areas such as nicks, gouges or undercuts, shall be verified by visual examination. Oxygen gouging, where required, is acceptable providing welding preheat is applied. Rewelding shall be performed in accordance with the procedure originally used to make the weld, or an alternate procedure approved in writing by the Engineers. Removal of attachment welds, when required, shall avoid removal of base material. Any remaining rough edges shall be ground flush with the surrounding surface and visually inspected to insure soundness.

4.03 FABRICATOR APPROVAL

A. The fabricator of structural load bearing members and assemblies furnished under this specification Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time

that Shop Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, shop detailing, shop coating, fabricating, delivering, and installing all miscellaneous metals and accessories needed to complete installations as shown on the Drawings, whether or not specifically listed herein, except those items specified in other sections. This section includes design engineering where specifically called for by this Section.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Shop Drawings shall indicate:

1) Types of materials with ASTM designations.

2) Plan layouts, elevations, and sections.

3) Connection details.

4) AWS weld designations and welding procedure.

5) Surface preparation and shop coatings.

6) Accessory materials.

b. Product literature for all materials and accessories required to complete the installation of the items covered in this Section.

c. Samples representative of materials and finished products.

d. Design and calculations shall be sealed by a professional structural engineer registered in the state where the Project resides on items where a design engineer is specified.

2. Information for the Record:

a. Welder qualification certificates.

b. Inspection Reports and test certificates.

c. Required field measurements.

d. Manufacturer’s installation instructions.

1.03 QUALITY ASSURANCE

A. Standards - Metal fabrications shall be designed, fabricated, and installed in accordance with following standards.

1. "Structural Welding Codes", American Welding Society.
2. "Specifications for Structural Steel Buildings" as approved by American Institute of Steel Construction.
3. "Specifications for the Design of Cold-Formed Steel Structural Members", American Iron and Steel Institute.
4. "Specification for the Design of Cold-Formed Stainless Steel Structural Members", ASCE 8.
5. "Code of Standard Practice for Steel Buildings and Bridges", as approved by American Institute of Steel Construction.
6. "Specification for Aluminum Structures", Aluminum Association.
7. "Specification for Structural Joints Using High Strength Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation.
8. "Surface Preparation Specification," Steel Structures Painting Council (SSPC).

B. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

1.04 PERFORMANCE REQUIREMENTS

A. Contractor is responsible for employing Design Engineer for the items listed by this Article. Design engineer shall follow the performance requirements provided in the pertinent parts of this Section.

1. Stairways.
2. Ladders.
3. Platforms simple end beam connections to steel or substrate.
4. Platforms simple end brace connections to steel or substrate.
5. Ductwork hangers and header steel as required to support duct.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall exercise particular care in handling materials to prevent damage to shop applied finishes and coatings.

B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.

C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

D. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed in same day shall be removed from storage.

1.06 PROJECT CONDITIONS

A. Prior to fabrication, Contractor shall field measure new and existing structures when required for proper fit.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel (Carbon Steel):

1. Wide Flange Shapes (W) - ASTM A992.
2. Other Rolled Shapes, Plate, and Bar - ASTM A36 or ASTM A572, Grade 50 as indicated on the Drawings. Where no indication is given, use ASTM A36.
3. Sheets - ASTM A570, Grade 36.
4. Hollow Structural Sections (HHS), tube and pipe - ASTM A500, Grade B.
5. Pipe - ASTM A53, type E or S, Grade B.
6. Floor and Tread Plate - ASTM A786 using ASTM A36 steel.

B. Stainless Steel:

1. Unless indicated otherwise stainless steel shall be AISI Type 304, except AISI Type 304L shall be used for welded construction. The minimum yield strength shall be 30,000 ksi.
2. Sheet, Strip, Plate, and Flat Bar - ASTM A666, annealed.
3. Round Bar and Structural Shape - ASTM A276, condition A.
4. Pipe and Tube - ASTM A312 or ASTM A554, annealed.
5. Floor and Tread Plate - ASTM A793.

C. Aluminum:

1. Unless specified otherwise aluminum shall be alloy 6061-T6.
2. Sheet and Plate - ASTM B209.
3. Rod and Bar - ASTM B211 or B221.
4. Pipe and Tube - ASTM B210 or ASTM B429.
5. Floor and Tread Plate - ASTM B632.

2.02 ASSEMBLY AND ERECTION FASTENERS

A. Bolts and Nuts:

1. High strength bolts - ASTM A325, Type 1 or ASTM A490, Type 1. When no indication is given, ASTM A325 shall be used.
2. Stainless Steel - ASTM F593, AISI Type 304.
3. High strength and stainless-steel bolts shall bear a distinctive head marking identifying bolt grade or material.
4. Nuts - Heavy hex style, ASTM A563, Grade C, for plain A325 high-strength fasteners and DH for galvanized bolts. For A490 bolts, heavy hex nuts conforming to ASTM A194 for Grade 2H, or ASTM A563 Grades DH or DH3.

B. Lock Nut - Prevailing torque type, IFI 100, Grade A.

C. Carbon Steel Washers - ASTM F436 plain with plain bolts and galvanized with galvanized bolts.

D. Lock Washer - Spring type of same material and coating as bolt.

E. Headed Studs - ASTM A108, Grade 1010 through 1020, and AWS D1.1, Section IV.

F. Screws:

1. Carbon Steel - SAE Grade 2, zinc plated.
2. Stainless Steel - IFI 104, Grade 304.

G. Nuts and washers of same finish and material as bolts shall be furnished

2.03 ANCHOR BOLTS

A. General Requirements:

1. Bolt and Stud Material:
2. Carbon Steel - ASTM F1554 Grade 36, unless noted otherwise.
3. Stainless Steel - ASTM F593, AISI Type 304.
4. Heavy hex nuts and washers of same material and coating as anchor shall be furnished. Where lock nut is indicated, prevailing torque type lock nut shall be furnished in addition to standard nut.
5. Anchor Bolt Sleeves:
6. Steel Pipe - ASTM A501, ASTM A120, or ASTM A53.
7. Plastic - Wilson “Ankor Shield” or equal.

B. Cast-In Anchor Bolt (Type A):

1. Sufficient thread length shall be provided to permit installation of nuts on both sides of concrete form or template.

2. Anchor embedment, and hook dimension shall be as shown on Drawings.

3. Where sleeve is shown, sleeve shall be fabricated from material indicated above.

C. Adhesive Anchor (Type B):

1. Adhesive – 100% solids, 100% reactive epoxy (ester-based resins are not permitted) in conformance with ASTM C881, Type IV, Grade 3, Class B and C. Minimum bond strength to concrete, per ASTM C882, shall be 1800 psi at 7 days. Adhesive shall be mixed in accordance with manufacturer's recommendations. The adhesive shall be formulated to withstand the maximum allowable published load permanently without creep or failure.

2. Where adhesive anchor is installed in hollow masonry, stainless steel screen tubes shall be furnished to contain adhesive until stud is inserted.

3. The anchor rods shall be threaded for entire length. Carbon steel rods shall conform to ASTM A193 B7 (high strength) and stainless-steel rods shall conform to AISI 304.

4. Stud shall be threaded full length.

5. Adhesive anchors shall be type "HIT-RE-500-V3" manufactured by Hilti, or equal. All formulations of the "Power-Fast Epoxy" as manufactured by Powers/Rawl shall not be used.

D. Expansion Anchor (Type C):

1. Wedge Type Anchors - FS A-A 1923A, Type 4.

2. All components shall be of same material.

3. Expansion anchors shall be type "Kwik Bolt TZ" manufactured by Hilti, or equal.

E. Sleeve Masonry Anchor (Type D):

1. Sleeve Type Anchors - FS FF-S-325, Group II, Type 3, zinc plated carbon steel.

2.04 EMBEDDED CHANNEL ANCHOR

A. Where embedded channel anchorage system is shown on Drawings, anchorage system shall be as manufactured by Halfen Anchoring Systems, or equal.

B. Load capacity, size, style, and material shall be as indicated on Drawings by Halfen model number.

C. Bolts shall be T-head bolts and shall be designed to be inserted anywhere in the channel and locked into position.

2.05 GASKETS

A. Where gaskets are required for the assembly or installation of metal fabrications, oil and gas resistant neoprene shall be furnished. Hardness of gasket shall be as appropriate for specific application.

2.06 WELDING

A. Carbon Steel:

1. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.
2. Welding shall be performed using only prequalified joint details in accordance with AWS Structural Welding Code.
3. Welding electrode shall conform to the requirements of AWS D1.1 and table 3.1 therein.
4. Welded fabrications which will be exposed to weather, submerged, or subject to sewage spray shall be continuously welded.
5. All welding processes and procedures and joint details shall be in accordance with the requirements of AWS D1.1. Weld quality shall conform to Section 8 of AWS D1.1.

B. Stainless Steel:

1. Stainless steel shall be welded with inert gas shielded process (GTAW, GMAW, or PAW). Inert gas protection shall be provided to top and under or backside of weld to ensure protection from atmospheric contamination.
2. Filler metal shall be extra low carbon (ELC) of appropriate type for base material being welded.
3. Residue, oxide, and heat stain in heat affected zone shall be removed.

C. Aluminum:

1. Aluminum shall be welded by process which does not require the use of welding flux.
2. Filler metal shall be as recommended by AA and AWS for base material and welding process used. Filler metal shall be selected to minimize crack sensitivity of weldment and to minimize discoloration of weldment on items to be anodized.

D. Welding shall be performed in such a manner to prevent warping and distortion.

E. Butt joints shall be made with full penetration welds. Weld reinforcement on back side shall be smooth, uniform, and no more than 1/16 inch in height.

F. Rough welds shall be ground to remove sharp edges, undercuts, pinholes and other irregularities. Chipping is permitted to remove sharp edges if followed by welding. Overgrinding, which would result in decreasing metal thickness or integrity of weld beyond limits of good welding practice shall be avoided.

G. Weld spatter shall be removed by chipping and grinding as required. Use of an anti-spatter coating applied adjacent to weld area prior to welding is permitted.

2.07 FABRICATION

A. Work shall be fabricated straight and true, free from warpage or other defects and assembled in a first-class workmanlike manner. Joints, copes, miters, and corners shall be accurately cut, machined, filed, and fitted with best methods as required for fabrication.

B. Work shall be fabricated as shown on approved Shop Drawings. Removable parts or members shall be carefully fitted and secured by screw fastenings or other methods as may be required.

C. Work shall be fabricated in as large as sections as practicable to minimize field connections. Field connections shall be designed and constructed in most practical locations for strength, appearance, and ease of installation. Field connections shall be mechanically fastened unless field welding is shown, specified, or permitted by Engineer.

D. Holes and other provisions for field connections shall be accurately located. Connections shall be shop checked for proper fit. Connection materials shall be match-marked when required for proper installation.

E. Holes produced by flame cutting shall be ground smooth.

F. Sharp edges of flame cut or sheared carbon steel fabrications shall be removed by power grinding.

G. Carbon steel surfaces to be coated or galvanized shall have gouges, handling marks, deep scratches, metal stamp marks, slivered steel and other surface flaws repaired. Surface flaws shall be repaired by welding and grinding as required.

2.08 SHOP COATING

A. Aluminum:

1. Anodizing - Where specified, provide Architectural Class I anodic coating, applied after fabrication.

2. Surfaces which will be in contact with concrete, masonry, or dissimilar metals shall receive a heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.

B. Carbon Steel:

1. Steel fabrications wholly embedded in concrete or masonry and with a minimum of 2 inches of concrete cover shall be abrasive blasted in accordance with SSPC SP-6, but shall not be coated. Exposed portions of partially embedded steel shall be shop coated to a point 4 inches below the concrete surface.

2. Galvanizing - Component shall be hot dip galvanized after fabrication in conformance with ASTM A123. Threaded parts and hardware shall be galvanized in conformance with ASTM A153 or zinc-plated in conformance with ASTM B695.

3. Painting - Unless specified otherwise, non-galvanized fabrications shall be shop primed per Section 09900.

   a. Surfaces which will be inaccessible for field painting after installation shall receive two coats of primer.

   b. Contractor shall ensure primer is compatible with specified field coatings.

2.09 ALUMINUM FLOOR PLATE AND FRAME

A. Floor plate covers shall be 3/8-inch minimum thickness aluminum tread plate. When shown on the Drawings, floor plate shall be furnished complete with welded aluminum stiffeners, aluminum frames, stainless steel lifting handles, stainless steel butt hinges, stainless steel fasteners, gaskets, and miscellaneous materials.

B. Plates shall be fabricated in pieces, such that no individual plate including stiffeners and hardware weighs more than 100 pounds. Plates shall have lifting hole at each corner unless gas-tight cover is indicated. Locate joints in floor panels only over supports unless shown otherwise.

C. Warped or bent plates shall be shop straightened to lie perfectly flat. Floor plate shall be secured to frame at each corner as a minimum with stainless steel fasteners.

D. Frame shall support all edges of floor plate. Frame shall be installed level and such that walking surface does not rock. Gas-tight installations shall be furnished with pre-punched neoprene gasket.

E. Type A frame shall be all-welded construction. Welds on exposed surfaces shall be ground flush.

F. Corners of Type B frames shall be mitered but not shop welded. Anchors shall be stainless steel.

2.10 FLOOR AND TRENCH GRATING FRAMES

A. Floor and trench grating frames shall be fabricated from materials indicated on Drawings. Frame shall be installed level and such that walking surface does not rock.

B. Type A frames shall be all-welded construction. Welds on exposed surfaces shall be ground flush.

C. Corners of Type B frames shall be mitered but not shop welded.

2.11 LADDERS

A. Design Engineer shall design framing and wall connections. Minimum requirements are provided on Drawings and specified.

B. Ladders shall be fabricated from material indicated on Drawings using all-welded construction. Safety cages shall be furnished when shown or otherwise required. Ladders shall meet requirements of MIOSHA and governing building code.

C. Edges of stringers shall be ground to remove burrs and sharp edges.

D. Rungs shall be spaced not less than 10 inches or more than 12 inches apart. Rungs shall have skid resistance top surface such as knurled, dimpled or skid resistant coating. Adhesive grit tape is not acceptable.

E. Where bottom landing is a roof, bottom of ladder shall be supported off wall, unless noted otherwise. Bottom rail floor connections shall have minimum 1-inch adjustment for slopped and uneven surfaces.

F. Ladder system shall be capable of supporting its own weight plus 300 pounds of allowable live load for every 10 feet of ladder height. Each rung shall support an allowable live load of 300 pounds located at the center of rung. Where ladder rails extend above the landing the rails shall be designed to support 100 pounds of lateral load in any direction located at the top of the rail.

G. The design of ladder bracket connections to substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the Design Engineer. Size and locations of removed materials for substrate verification, or to be strength tested shall receive prior approval by the Owner and Engineer.

2.12 OPENING FRAMES

A. Members forming opening frames shall be selected for trueness of section and straightness.

B. Frames for wall opening shall be fabricated from carbon steel structural shapes or plates as shown on Drawings. All-welded construction shall be used unless shown otherwise. Welds on exposed surfaces shall be continuous and ground flush.

C. Furnish fasteners and anchors of type shown.

D. Where structural lintel is shown, lintel shall be welded to frame.

2.13 LOOSE LINTELS

A. Lintels shall be carbon steel fabricated from steel angles or other shapes as shown on plans. Ends of lintel shall bear a minimum of 4 inches on concrete or masonry.

B. Galvanize loose steel lintels located in exterior walls.

2.14 PLATFORMS

A. Platforms include metal walking surfaces that are not part of the structural steel package of the main building, such as walkways, catwalks and platforms around equipment

B. Design engineer shall design simple connections and provide signed and sealed calculations for platforms. Simple connections are beam and brace connections that resist bearing, shear and axial forces and are not required to resist moment forces. For standard double angle connections designed by steel construction manual tables a signed and sealed certified letter will be accepted in lieu of calculations

C. Support members of metal platforms shall be fabricated from carbon steel, unless shown otherwise. Refer to Drawings for member sizes.

D. Shop connections may be bolted or welded. Field connections shall be bolted, unless shown otherwise. Beam connections shall have a minimum of two row of bolts and connecting angles or plates shall be at least half the depth of the connected beam.

E. Where detailed connections are not shown and end reactions are not indicated on the Drawings, member connections shall be designed to support 50% of the total uniform load for the member span as given by the “Maximum Total Uniform load, kips table of the latest edition of the Steel Construction Manual as published by AISC. Use 50 ksi steel ASD tables for W-sections, WT-Sections, M-sections and S-sections. Use 36 ksi steel ASD tables for C-sections, MC-sections and Angles. The connections shall be designed for greater loads when these loads are indicted on the drawings.

F. Connection design shall take into account block-shear-tension-rupture, block-shear-shear-yielding, block-shear-shear-rupture, bolt hole bearing strength and flange coping.

G. Connection designs shall take into account pre-tensioned and slip critical conditions when indicated on the drawings.

H. Design engineer shall design connection with slotted holes to allow for construction tolerances as deemed necessary by the contractor or where shown on the Drawings.

I. Bolted connections shall be designed using 3/4"-inch ASTM A325 bolts in Snug-Tightened condition, unless noted otherwise. Bolt thread condition shall be Type N or Type X. Provide a minimum of two 3/4-inch bolts per connection.

J. Provide pretensioned or slip-critical bolted joint connections where specified or indicated on the Drawings. Refer to specification 05120 for additional joint requirements.

K. Walking surface shall be as indicated on Drawings:

1. Tread plate shall be secured with 3/8-inch countersunk bolts or screws. Plates shall be secured at each corner as a minimum.

2. Grating shall be secured with 3/8-inch minimum bolts and grating clips as specified in Section 05530. Grating panels shall be secured at each corner as a minimum.

3. Fasteners for aluminum plate and grating shall be stainless steel and fasteners for steel plate and grating shall be galvanized or zinc-plated carbon steel.

L. Holes for attachment of metal stairs, metal pipe railings, and other equipment shall be provided where required.

M. Where walking surface serves as top step in flight of stairs, nosing shall be furnished to match stair treads.

N. Exterior steel framing and steel framing over tanks and channels shall be galvanized, unless noted otherwise.

2.15 RESERVED

2.16 PIPE BOLLARDS

A. Metal pipe bollards shall be constructed as shown on the Drawings.

B. Metal pipe shall be hot dipped galvanized, unless noted otherwise on Drawings.

C. Plastic bollard guards shall be provided when specified in Part 4.

PART 3 EXECUTION

3.01 ERECTION

A. Metal fabrications shall be installed in accordance with manufacturer's instructions and as shown on Drawings.

B. Fabrications shall be installed level and plumb or as otherwise shown on Drawings. Shims shall be furnished when required.

C. Components shall be assembled as indicated on Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not permitted. Where holes do not match, holes may be reamed slightly using a tapered reamer. Enlarging holes by burning is prohibited.

D. Contact surfaces between members and areas adjacent to bolt holes shall be free of dirt, oil, loose scale, burrs, pits, and other defects that would prevent proper seating and connection of the members.

E. Galvanized or anodized material shall not be field bent, cut, welded, or otherwise altered. Material so altered will be considered defective.

3.02 ASSEMBLY AND ERECTION FASTENER INSTALLATION

A. Washers shall be installed under turned element of bolts. Hardened washers shall be used for high strength and alloy bolts. Beveled washers shall be installed when bearing surface of the bolted parts have a slope of 1:20 or greater with respect to the bolt axis.

B. Fastener threads which have been contaminated with dirt shall be cleaned and lubricated.

C. Stainless Steel - Anti-seizing lubricant shall be applied to threads prior to installation.

D. Bolts shall be tightened progressing systematically from stiffest part of connection toward free edges.

E. Bolted connections shall be snug-tightened-joints, unless noted otherwise. All connected steel plies shall be free of dirt, oil, lacquer and burrs, and shall be in firm contact prior to bolting.

F. High strength and alloy bolts shall not be reused once tightened beyond snug-tight.

G. For bolted connections, at least one full thread shall project beyond the nut when tightened.

3.03 ANCHOR BOLT INSTALLATION

A. Non-cast-in type anchors shall be installed in predrilled holes of size specified or as recommended by manufacturer. Anchors shall be embedded to depth indicated below unless shown otherwise on the Drawings.

B. Anchor bolted connections shall be snug-tightened- in accordance with “Specification for Structural Joints Using ASTM A325 or A490 Bolts” as approved by the Research Council on Structural Connections of the Engineering Foundation or as otherwise specified by anchor manufacturer.

C. Expansion Anchor:

1. Unless indicated otherwise, expansion anchors shall have an effective embedment as follows:

Stud Diameter	Minimum Embedment
1/4 inch	2 inches
3/8 inch	2 inches
1/2 inch	3-1/4 inches
5/8 inch	4 inches
3/4 inch	4-3/4 inches
1 inch	6 inches

2. Unless indicated otherwise, expansion anchors shall be spaced as follows:

Minimum center to center spacing: 2 times embedment.

Minimum edge distance: 3 times embedment.

3. Unsound concrete shall be reported to Engineer.

D. Adhesive Anchor:

1. Adhesive anchors shall be placed in holes larger than stud diameter using a rotary percussion hammer and carbide bit. Hole diameters shall be as recommended by manufacturer for each specific anchor diameter.

2. Unless indicated otherwise, Adhesive anchors shall have an effective embedment as follows:

Stud Diameter	Minimum Embedment
3/8 inch	3-3/8 inches
1/2 inch	4-1/2 inches
5/8 inch	5 5/8 inches
3/4 inch	6-3/4 inches
7/8 inch	7-7/8 inches
1 inch	9 inches

3. Preparation Procedure:

a. Hole shall be cleaned of dust and residue by blasting with dry and oil-free compressed air. Air nozzle shall be inserted to bottom of hole.

b. Sides of hole shall be cleaned with a nylon bristle brush.

c. Compressed air blast shall be repeated.

4. Standing water and frost shall be removed immediately prior to injecting adhesive.

5. Adhesive shall be injected from bulk-loading caulking gun, disposable caulking tubes, or pneumatic dispenser. Adhesive shall be injected using extension on nozzle to reach bottom of drilled hole.

a. Anchoring to Concrete - Nozzle shall be inserted to back of hole and adhesive dispensed while slowly withdrawing nozzle. Hole shall be filled to pre-determined depth which will cause hole to be completely filled after stud is inserted.

b. Anchoring to Masonry - Screen tube shall be filled with adhesive while slowly withdrawing nozzle. Screen tube shall be carefully inserted into drilled hole.

6. Stud shall be pushed into adhesive with gentle, uniform pressure while slightly rotated to ensure adhesive completely surrounds stud. Stud shall be inserted to full depth of hole.

7. Adhesive displaced from hole shall be removed immediately. Adhesive which has hardened on projecting portion of stud or on concrete surfaces shall be removed.

8. Nut shall not be tightened nor load applied until adhesive has fully cured as recommended by manufacturer.

9. Threaded anchors shall have at least one full thread projecting beyond the nut when tightened.

3.04 FASTENER AND ANCHOR SCHEDULE

A. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

Base Metal	Fastener Metal and Coating
Stainless steel	Stainless Steel
Aluminum	Stainless Steel
Galvanized steel	Galvanized or zinc plated carbon steel
Field painted or uncoated carbon steel	Unfinished or zinc plated carbon steel

B. Where a connection involves dissimilar base metals, fastener shall be as required for most corrosion resistant base metal in connection, or dielectric material shall be installed.

C. Anchors bolts and fasteners in submerged applications shall be stainless steel.

D. Where anchor type is not shown or specified, anchor furnished shall be suitable for substrate material and specific application. Adhesive anchors are not permitted for anchoring to vertical or overhead surfaces inside of buildings or other fire rated locations.

Substrate Material	Suitable Anchor Type
Concrete	A, B, C
Solid or Grouted Masonry	A, B, D
Hollow Masonry	B, D

3.05 FIELD WELDING

A. Field welding when shown, specified, or otherwise permitted by Engineer shall be performed in accordance with the requirements specified for shop welding.

B. Areas adjacent to field welds shall not be shop primed. Primer shall be applied after welding.

3.06 COATING REPAIR

A. Welds, bolts, and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.

B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.

C. Repair of anodized coatings in field is not permitted. Damaged materials shall be removed and re-anodized.

3.07 CLEANING

A. Metal fabrications shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

3.08 QUALITY CONTROL INSPECTION AND TESTING

A. The Contractor shall employ a laboratory to perform the following inspections and testing verifications: Where pretensioned or slip critical connections are indicated refer to Section 05120 for additional inspection requirements.

1. At the start of Work, the inspector at the Site of the project shall:

   a. Verify that the material identification markings for structural members, high strength bolts, nuts and washers correspond to the appropriate ASTM designations.

   b. Verify that on-site welders designated by the Contractor are certified to perform welding

   c. Verify that the proper welding electrodes, equipment, and procedures are being utilized

2. Periodic inspections:

   a. Verify that the material identification markings for structural members correspond to the appropriate ASTM designations. This verification shall be performed for each building of the project and for every six months of any one building's construction.

   b. Verify that material identification markings for high strength bolts, nuts and washers correspond to the appropriate ASTM designations. This verification shall be performed every 400 bolts.

   c. Verify that connection details for beam, columns and braces comply with construction drawings. Inspect every 10th connection joint or portion thereof.

   d. Observe that Snug-Tightened-Joints are being properly connected per Section 9 of the Specification for Structural Joints Using ASTM A325 or A490 bolts as approved by RCSC. Verify connection plies are free of burrs and are in firm contact with each other. Verify connections have the correct number of bolts with the correct type of nuts and washers. Inspect every 10th connection joint or portion thereof.

   e. Verify that the proper welding electrodes, equipment and procedures are being utilized. Perform this verification once each month of construction.

   f. Visually inspect all welded connections using AWS D1.1, Table 6.1 acceptance criteria, except as modified by Section J2 of the ANSI/AISC

360-5 Specification for Structural Steel Buildings, prior to project completion. Observe the welding work in progress once a week of the following types:

1) Single-pass fillet welds not exceeding 5/16 inch in size.

2) Welding of stairs and handrails.

3. Continuous Inspections:

a. Visually inspect all welded connections using AWS D1.1, Table 6.1 acceptance criteria, except as modified by Section J2 of the ANSI/AISC 360-5 Specification for Structural Steel Buildings. Continuously observe the welding work in progress of the following types:

1) Complete and partial joint penetration grove welds.

2) Multi-pass fillet welds.

3) Single-pass fillet welds greater than 5/16 inch in size.

4) Plug and slot welds.

5) Welds of reinforcing bars to structural.

4. If inspections determine that a specific item does not comply with the Contract Documents the contractor shall make corrections until the item passes the inspection. The cost of corrections and additional inspections shall be paid for by the Contractor.

PART 4 SPECIAL PROVISIONS

4.01 DISSIMILAR MATERIALS

A. Where dissimilar materials come into contact, use neoprene washers, spacers, gaskets, or other Engineer approved materials between them to provide insulation against electrolytic action.

4.02 CRITERIA FOR BASE METAL REPAIR OF STRUCTURAL STEEL

A. This criteria shall cover damage induced to existing structural steel during or subsequent to installation of steel. Injurious imperfections, such as voids and gouges, shall herein be defined as a base metal discontinuity which results in a reduction of the cross-sectional area of a member, and which exceeds the limiting depths specified below for various thicknesses of material. Except for discontinuities of 1/32-inch and less in depth which are acceptable without any repair, base metal shall be conditioned for the removal of discontinuities by chipping or grinding. Weld repair is not required, provided the excavated area is well faired without abrupt changes in contour and the depression does not extend below the rolled surface by more than:

1. 1/32 inch for material less than 3/8 inch thick.

2. 1/16 inch for material 3/8 inch to 2 inches (inclusive) thick.

3. 1/8 inch for material over 2 inches thick.

B. Voids and gouges greater in depth than the limits given above and all cracks and tears are considered injurious and shall be weld repaired using the methods given below; however, in no case shall the depth of excavations exceed 30% of the base metal thickness without written approval of the Engineers. Prior to welding, the excavations shall be visually (and for cracks and tears, magnetic particle or liquid penetrant) examined to insure complete removal of defects. Excavations shall have a minimum root radius of 1/8 inch, a minimum included angle of 45 degrees F on the cross section, and shall be gradually tapered up to the base metal surface at the ends. Repair welding shall be performed in accordance with the parameters of an AWS D1.1 qualified backing bar weld procedure. Completed surfaces of all repair welds shall be visually examined to the acceptance criteria of AWS D1.1 Section 8.15.

4.03 CRITERIA FOR REPAIR OF WELD DEFECTS AND DAMAGED WELDS

A. Repair of damage or discontinuities in previously completed welds shall be in accordance with the criteria outlined below. In conjunction with the requirements outlined in weld procedure W200A, defects in welds shall be removed by chipping, arc-gouging, or grinding until sound metal is reached. Removal of indications such as cracks or tears, shall be verified by magnetic particle or liquid penetrant examination. Removal of other indications or damaged areas such as nicks, gouges or undercuts, shall be verified by visual examination. Oxygen gouging, where required, is acceptable providing welding preheat is applied. Rewelding shall be performed in accordance with the procedure originally used to make the weld, or an alternate procedure approved in writing by the Engineer. Removal of attachment welds, when required, shall avoid removal of base material. Any remaining rough edges shall be ground flush with the surrounding surface and visually inspected to assure soundness.

4.04 FABRICATOR APPROVAL

A. The fabricator of structural load bearing members and assemblies furnished under this Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time that Shop Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

4.05 PLASTIC BOLLARD GUARDS

A. Pipe bollards cover shall be a closed top, 1/8-inch-thick HDPE with UV inhibitors and rated for outdoor environment. The bollard cover shall be integrally colored; Owner

shall select color. A reflective striping, as specified, shown or required shall be a 3M #680 reflective self-adhesive tape which is compatible with the HDPE cover and exterior rated. The striping pattern and colors, shall be as specified, shown or as required. HDPE covers shall provide for a uniform height of bollards. Contractor shall coordinate bollard cover size with the metal pipe bollard as shown on the Drawings.

END OF SECTION

SECTION 05510
METAL STAIRS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes detailing, fabrication, installation and furnishing metal grating, checkered plating, concrete filled steel pan stairs, including but not limited to stringers, treads, shop coating and delivery. Provide design engineering where indicated by this section.

B. Railing is specified in Section 05520.

C. Nosing is specified in Section 05550.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Shall indicate:

1) Materials of construction and structural member sizes.

2) Stair framing plan, elevation and sections. Provide building plan indicating stair locations.

3) Pertinent dimensions and elevations.

4) AWS weld designations and welding procedure.

5) Surface preparation and shop coatings.

6) Accessory materials.

7) Required field measurements.

8) Design loads and end reactions.

9) Design and calculations shall be sealed by a professional structural engineer registered in the state where the Project resides on items where a design engineer is specified

2. Information for the Record:

a. Welding qualification certificates.

b. Material certification.

c. Field Measurements.

1.03 QUALITY ASSURANCE

A. Standards - Metal stairs shall be designed, fabricated, and installed in accordance with following standards:

1. "Metal Stairs Manual", National Association of Architectural Metal Manufacturers.
2. "Structural Welding Code", American Welding Society.
3. "Specifications for Structural Steel Buildings", American Institute of Steel Construction.

B. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

1.04 PERFORMANCE REQUIREMENTS

A. Contractor is responsible for employing design engineer for stairs indicated as "pre-engineered" in stair table on drawings. The design engineer shall follow the performance requirements of this Section.

B. All stairs, treads and landings shall be capable of supporting a uniform live load of 100 pounds per square feet and a concentrated load of 300 pounds, unless designated as Heavy Duty. Framing shall be able to withstand the concentrated load placed at any location on the stair. Loads need not act congruently.

C. Where stairs are indicated as Heavy Duty, the stairs, treads and landings shall be capable of supporting a uniform live load of 200pounds per square feet and a concentrated load of 1,000 pounds. Framing shall be able to withstand the concentrated load placed at any location on the stair. Loads need not act congruently.

D. Sizes and thicknesses of stair components given in this specification and shown on the Drawings are minimums. All components shall be sized as required for the above-specified design loads.

E. Stair configurations and accessories shall meet the requirements of OSHA and local building codes, unless more stringent requirements are noted.

F. Stair framing deflection shall be limited to Span/360 for live load and to Span/240 for the combination of live and dead loads.

G. Stair treads and landings shall be limited to a deflection of Span/360, with 1/8-inch maximum deflection.

H. The contractor shall provide engineered design for pre-engineered stairs. The framing and connections shall be designed by a professional engineer registered in the state where the project resides. The Contract Documents indicated minimum standards to be followed. Shop drawings shall stipulate more stringent requirements where required by the design engineer to meet the performance criteria and specified codes.

I. For pre-engineered stairs, the framing connections to the substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the design engineer. Size and locations of removed materials for substrate verification or to be strength tested shall receive prior approval by the Project Engineer

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall exercise particular care in handling materials to prevent damage to shop applied coatings.

B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.

C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

D. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed in same day shall be removed from storage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled Shape, Plate, and Bar - ASTM A36.

B. Sheets - ASTM A570, grade 36.

C. Pipe and Tube - ASTM A501 or ASTM A53, Type E or S, grade B.

2.02 FASTENERS AND ANCHOR BOLTS

A. Fasteners and anchor bolts shall be furnished and installed in accordance with Section 05500.

2.03 STRINGERS

A. Stringers shall be minimum C10x15.3 channels with end closures. Unless shown otherwise, stringers and related carbon steel components shall be painted for interior applications and galvanized for exterior applications.

2.04 TREADS AND LANDINGS

A. Metal stair treads shall be grating, unless noted otherwise.

B. Tread widths shall be approximately 1-inch greater than nose to nose tread dimensions shown on Drawings.

C. Where landing platforms serve as the top step in a flight of stairs, they shall be furnished with nosings to match treads.

D. Grating for landing platforms shall be of material as shown on the Drawings and shall be as specified under Section 05530.

E. Grating treads shall be pre-manufactured from by Brown-Campbell, McNichols Co., or equal. Refer to Drawings for grating material. Minimum steel and stainless streel grating landing and tread depth shall be 1-inch and minimum aluminum tread depth shall be 1 1/2-inch. Treads shall be bolted to stringers.

F. Aluminum checkered plate for treads, risers, and landings shall meet the requirements of ASTM B362. Steel checkered plate for treads, risers, and landings shall meet the requirements for ASTM A786 using ASTM A36 steel. Thickness shall be 3/8-inch minimum, with additional stiffeners where necessary to meet loading and deflection criteria.

G. Steel pan stairs shall use minimum 12-gauge steel for treads, risers, and landings with additional stiffeners where necessary. Pan tread concrete fill shall be 2-inch thick. Pan landing concrete fill shall be 3-1/2 inches minimum.

2.05 NOSINGS

A. Provide nosing in accordance with the requirements of Section 05550.

2.06 RAILING

A. Provide railing in accordance with the requirements of Section 05520.

2.07 FABRICATION

A. Stairs shall be shop fabricated in as large of sections as practicable, and in accordance with approved Shop Drawings. Stairs shall be accurately framed, true to line and slope, accurately mitered and joined and securely and rigidly supported.

B. Shop connections may be bolted or welded. Field connections shall be bolted, unless shown otherwise. Where connection details are not shown, stringer and stair support connections shall be designed to develop 75% of the maximum allowable uniform beam load obtained from AISC tables.

C. Bolted stringer and support connection shall use high strength bolts; minimum of two bolts per connection. Minimum bolt size shall be 3/4-inch. Bolted connections in the travel path shall be made with countersunk fasteners.

D. Holes and other provisions for field connections shall be accurate and shop checked for proper fit in the field. Holes produced by flame cutting shall be ground smooth.

E. Welding electrode for steel shall be E70XX. Welded joints which are exposed shall be continuous, smooth, and flush. Weld spatter and burrs shall be removed by grinding after fabrication.

F. Surfaces to be coated shall have gouges, handling marks, deep scratches, metal stamp marks, slivered steel and other surface flaws repaired. Surface flaws shall be repaired by welding and grinding as required. Sharp edges of flame cut or sheared steel shall be removed by power grinding.

2.08 SHOP COATING

A. Galvanizing - Steel components shall be hot dip galvanized after fabrication in conformance with ASTM A123. Threaded parts and hardware shall be galvanized in conformance with ASTM A153 or zinc-plated in conformance with ASTM B695.

B. Painting - Non-galvanized steel components shall be shop primed and field painted per Section 09900.

PART 3 EXECUTION

3.01 COORDINATION

A. Prior to fabrication, Contractor shall field measure structures when required for proper fit of stairs.

3.02 INSTALLATION

A. Stairs shall be erected true to line and slope, rigidly supported and shall be braced and tightened against movement. Treads shall be level and shall be aligned and spaced accurately.

B. Components shall be assembled as shown on approved Shop Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not allowed. Where holes do not match, holes may be reamed slightly using a tapered reamer. Enlarging holes by burning is prohibited.

C. Contact surfaces between members and areas adjacent to bolt holes shall be free of dirt, oil, loose scale, burrs, pits, and other defects that would prevent proper seating and connection of members.

D. Galvanized material shall not be field bent, cut, welded, or otherwise altered. Material so altered will be considered defective.

E. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surface adjacent to field weld.

F. Whenever dissimilar metals come into contact, use neoprene washers, spacers, gaskets or other approved material between them to provide insulation against electrolytication.

3.03 COATING REPAIR

A. Welds, bolts and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.

B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.

3.04 CLEANING

A. Stairs shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 05520
METAL PIPE RAILING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, engineering, shop detailing, fabricating, shop coating, and installing of metal pipe railing systems and appurtenances.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Shop Drawings shall include:

1) Plan layouts, elevations and typical sections.

2) Materials of construction.

3) Connection details.

4) AWS weld designations and welding procedure.

5) Surface preparation and shop coatings.

6) Accessory materials.

7) Required field measurements.

8) Design certification for connection of mechanically connected railing systems.

9) Seal of professional structural engineer registered in the state where the Project resides.

b. Product literature.

c. Sample of railing showing typical welds and required finish.

2. Information for the Record:

a. Welding qualifications.

b. Material certification.

c. Manufacturer’s installation instructions.

1.03 QUALITY ASSURANCE

A. Standards - Railing shall be fabricated, and erected in accordance with following standards.

1. "Pipe Railing Systems Manual", National Association of Architectural Metal Manufacturers, AMP 521.
2. "Specifications for Structural Steel Buildings", American Institute of Steel Construction.
3. "Specification for Aluminum Structures", Aluminum Association.
4. "Structural Welding Codes", American Welding Society.

B. Regulatory Requirements - Railing shall be fabricated, and erected to comply with OSHA and applicable Building Code where Project resides.

C. Welders, Welding Operators, and Tack Welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Railing shall be handled in manner to prevent damage to shop applied coatings.

B. Railing shall be stored in manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.

C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

PART 2 PRODUCTS

2.01 ALUMINUM RAILING

A. Plate - ASTM B209, alloy 6061-T6.

B. Structural Shape - ASTM B308, alloy 6061-T6.

C. Rod and Bar - ASTM B211 or B221, alloy 6061-T6.

D. Pipe and Tube - ASTM B429, alloy 6005-T5, 6061-T6, or 6105-T5.

E. Connector Fitting for Mechanical Railing System:

1. Fitting shall be cast aluminum magnesium alloy conforming to ASTM B26 with minimum ultimate strength of 40 ksi, and minimum yield strength of 20 ksi.
2. Fitting shall be internal double tang type activated by 3/8-inch stainless steel knurled cup socket setscrew, externally connected to rail or post by means of aluminum tubular rivet nut and stainless-steel socket head cap screw.
3. Railing system shall be Internal-Rail as manufactured by The Hollaender Mfg. Co., or equal.

F. Railing Post Base Support Fittings:

1. All aluminum railing post support fittings, facia brackets, wall brackets, floor flanges, etc. shall be cast, extruded, or fabricated using aluminum alloys as follows:

a. Extruded aluminum fittings shall be made of 6063-T6 alloy.

b. Cast fittings shall be made from aluminum-magnesium alloy conforming to ASTM B26 with minimum ultimate strength of 40 ksi and minimum yield strength of 20 ksi.

c. Railing post base support fittings shall be as manufactured by the Hollaender Mfg. Co., or equal.

2.02 FASTENERS AND ANCHOR BOLTS

A. Fasteners and anchor bolts shall be furnished and installed in accordance with Section 05500.

B. Hardware for aluminum and stainless-steel railing shall be stainless steel. Hardware for carbon steel railing shall be galvanized or zinc-plated carbon steel.

2.03 RAILING SYSTEM

A. Railings shall be shop fabricated using mechanical connections in as large of sections as practicable. Holes required for field erection shall be shop drilled.

B. Field splices shall be made with an internal sleeve and steel screws. Splices shall be located within 6 inches of post.

C. Expansion Joints:

1. Expansion joints shall be provided in straight runs of railing in excess of 40-feet and at structural expansion joints.

2. Expansion joints shall have internal sleeve extending 2-inch beyond joint on each side.

D. Unless otherwise specified on the Drawings, posts and rails shall be 1-1/2-inch pipe, schedule 40 minimum. Railing system shall consist of top rail, intermediate rail or rails and posts with 4-inch high toe plate stiff enough to resist warping due to temperature changes.

E. Posts shall be 1 1/2-inch nominal diameter and reinforced with internal metal stud as required by design; however, where top of post connections are more than 9-inches below the walking surface, a 2-inch nominal maximum diameter post shall be used. Top and intermediate rails shall match the diameter of the posts. Balusters shall be 5/8-inch diameter minimum and provided when indicated on Drawings.

F. Provide internal reinforcing and stud where necessary to meet strength requirements.

G. Post spacing shall not exceed the maximum spacing of 5 feet.

H. Handrail bracket spacing for wall mounted railings shall not exceed 5-feet.

I. Access openings in railings shall be provided where shown on the Drawings. Openings shall be spanned with two 1/4-inch stainless steel chains with swivel eye spring snap hooks and stainless-steel eyebolts.

J. Handrails shall be 1 1/2-inch nominal diameter and continuous between flights of stairs or runs of ramp, and shall return to railing post at top and bottom terminations. Wall mounted handrail shall be furnished with returns to wall.

K. Self-closing swing gates shall be provided where indicated on plan. Furnish 180-degree heavy duty spring hinges, closure stops, top rail, bottom rail, intermediate rail or balusters that match the encompassing railing system

2.04 PERFORMANCE REQUIREMENTS

A. Railing systems and their connections shall be designed by a professional engineer registered in the state where the project resides. Contractor is responsible for employing Design engineer

B. Contract Documents indicated minimum standards, shop drawings shall stipulate more stringent requirements where required by the Design engineer to meet the performance criteria.

C. The design of railing post connections to substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the Design engineer. Size and locations of removed materials for substrate verification or to be strength tested shall receive prior approval by the Engineer.

D. Railing system shall be detailed and installed as shown on Drawings and capable of supporting the following loads without exceeding the allowable design working stresses of the materials, anchorages, and connecting devices utilized. The allowable working stresses shall be as defined by the applicable building codes and material standards. Each load shall be applied so as to produce the maximum stress in each of the respective components and post base connections. The following load cases shall be considered separately.

1. Top rail of guardrail and handrails.
    a. 200 pounds concentrated load applied in any direction at any point along the rail.
    b. 50 pounds per linear feet applied in any direction along the rail.
2. Intermediate rail:
    a. 50 pounds per linear feet applied in any direction along the rail.

3. Panel Fillers, Spindles and balusters

   a. 150 pounds per one square foot applied in any direction where load produces the maximum stress on the panel, spindles or balusters.

4. Maximum 2-inch deflection at top of railings.

2.05 FABRICATION

A. The railing system shall be fabricated as specified herein and as shown on the Drawings.

B. Rail-to-end post and rail-to-corner post connections shall be formed with accurately mitered joints. Other changes in rail direction shall be formed by radius bends.

C. Elbow bends and wall returns shall be formed to uniform radius, free from buckles and twists, with smooth finished surfaces.

D. Exposed ends of pipe and tube shall be closed with welded metal closures or prefabricated fittings.

E. Burrs, sharp edges, and other projections shall be removed. Exposed cut edges shall be blunted by grinder.

F. Joints shall be fabricated so as to exclude water. Weep holes shall be provided in locations where water may accumulate.

2.06 SHOP COATING

A. Aluminum:

1. Aluminum railing shall have Architectural Class I, anodic coating applied after fabrication.

2. Surfaces which will be in contact with concrete or masonry or dissimilar metals shall receive heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.

B. Carbon steel railing shall be hot dip galvanized after fabrication in conformance with ASTM A123.

PART 3 EXECUTION

3.01 COORDINATION

A. Prior to fabrication, Contractor shall field measure structures to which railing is attached.

3.02 INSTALLATION

A. Railing shall be installed in accordance with manufacturer’s instructions. Railing shall be installed straight and level or parallel to rake of steps and ramps as required.

B. Railing shall be placed on both sides of stairs and ramps. All ramps higher than 6-inches shall be provided with railings.

C. Type V handrail shall be installed 34 inches above the leading edge of the stair treads or ramp surface. Type V handrail shall be provided along interior and exterior stairs and ramps that run along walls, unless noted otherwise on the Drawings.

D. Components shall be assembled as indicated on Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not permitted. Enlarging holes by burning is prohibited.

E. Field bending, cutting, welding, or other altering of galvanized or anodized material is not permitted. Railing so altered will be considered defective.

3.03 COATING REPAIR

A. Welds, bolts, and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.

B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.

C. Repair of anodized coatings in the field is not permitted. Damaged railing shall be removed and re-anodized.

3.04 CLEANING

A. Railing shall be cleaned as it is installed using ordinary wax cleaners, soaps, or mild detergents. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 05530
METAL BAR GRATING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing, shop detailing, fabricating, shop coating, and installing grating as shown on the Drawings and specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review.

a. Shop Drawings shall indicate:

1) Layout of grating panels.

2) Location of openings.

3) Accessory materials.

4) Required field measurements.

b. Product literature.

c. Samples of each type of grating required.

2. Information for the Record:

a. Span tables.

b. Installation instructions.

1.03 QUALITY ASSURANCE

A. Standards - Grating shall be designed, fabricated, and installed in accordance with the following standards.

1. “Metal Bar Grating Manuals” MBG531 (Aluminum and Light Duty Steel Grating) and MBG532 (Heavy-Duty Steel Grating), National Association of Architectural Metal Manufacturers (NAAMM).

1.04 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall exercise particular care in handling materials to prevent damage to shop applied coatings.

B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.

PART 2 PRODUCTS

2.01 STEEL GRATING

A. Bearing Bars - 3/16-inch thick carbon steel conforming to ASTM A569 or ASTM A36, with a rectangular cross-section and spaced at 1-3/16-inch centers. Where accessible grating is indicated, bearing bars shall be spaced at 11/16-inch centers. The depth of bearing bars shall satisfy loading and span requirements but shall not be less than shown on the Drawings.

B. Banding Bars - 1/4-inch thick carbon steel conforming to ASTM A36.

C. Cross bars shall be spaced at 4-inch maximum and resistance welded to bearing bars.

D. Surface of grating shall be plain unless noted otherwise.

2.02 ALUMINUM GRATING

A. Bearing Bars - 3/16-inch thick alloy 6061-T6 or 6063-T6 conforming to ASTM B221, rectangular in cross-section and spaced at 1-3/16-inch centers. Where accessible grating is indicated, bearing bars shall be spaced at 11/16-inch centers. The depth of bearing bars shall satisfy loading, span, and deflection requirements but shall not be less than shown on the Drawings.

B. Banding Bars - 1/4-inch thick alloy 6061-T6 or 6063-T6 conforming to ASTM B221.

C. Cross bars shall be spaced at 4-inch maximum. Bearing bars shall be punched to receive cross bars. Cross bars shall be inserted through punched holes in bearing bar and swage-locked to prevent turning, twisting, or loosening.

D. Surface of grating shall be plain unless other surface types are shown on the Drawings.

2.03 HEAVY-DUTY STEEL GRATING

A. Bearing Bars - 3/8-inch thick carbon steel conforming to ASTM A36 spaced at 1-7/8-inch centers.

B. Banding Bars - 3/8-inch thick carbon steel conforming to ASTM A36.

C. Cross bars shall be spaced at 4-inch maximum and resistance welded to bearing bars.

2.04 FASTENERS

A. Where fastening of grating is shown or specified:

1. Grating less than 2-1/2-inch deep shall be secured with saddle type grating clips. Clips for aluminum grating shall be stainless steel. Clips for steel grating shall be galvanized.

2. Grating 2-1/2-inch and deeper shall be secured by means of anchor blocks welded between bearing bars.

2.05 PERFORMANCE REQUIREMENTS

A. Grating shall be capable of supporting uniform live load of 100 pound per square feet or a moving concentrated load of 300 pounds, whichever results in a stronger design, unless noted otherwise.

B. Deflection shall not exceed 1/4-inch for the required span and specified loads.

C. Unit stress in bending for steel grating shall not exceed 20,000 psi. Steel shall conform to ASTM A36.

D. Unit-stress in bending for aluminum grating shall not exceed 12,000 psi. Grating shall be made of aluminum alloy 6061-T6 or 6063-T6 conforming to ASTM B221.

E. All grating shall comply with OSHA General Industry Regulations, latest edition.

2.06 FABRICATION

A. Bearing bar shall be rectangular in cross section. Depth shall be as shown or specified, but not less than that required to meet specified loading and deflection criteria. Minimum depth shall be 1-inch

B. Notching, cutting, or slotting top or bottom of bearing bars is prohibited.

C. Grating panels shall bear a minimum of 1-inch on structural supports or grating frame.

D. Ends of grating panels shall be finished with trim banding bars. Depth of trim banding shall be 1/4-inch less than depth of bearing bar. Trim banding shall be attached flush to the walking surface and welded to bearing bars at 5-inch maximum spacing.

E. Holes and cutouts shall be shop cut and banded. Banding bars shall be full depth of grating and shall be welded to each bearing bar.

2.07 SHOP COATING

A. Aluminum Grating - Surfaces which will be in contact with concrete, masonry, or dissimilar metal shall receive heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.

B. Steel Grating - Grating shall be hot dip galvanized after fabrication in conformance with ASTM A123.

PART 3 EXECUTION

3.01 COORDINATION

A. Contractor shall field measure grating frames and openings and locate obstructions which will pass through grating prior to fabricating grating.

B. Contractor shall coordinate size and locations of openings in grating with other Work.

3.02 INSTALLATION

A. Grating shall be installed in accordance with manufacturer's instructions. Cross bars shall be on top.

B. Grating shall be set flush with surrounding surface and shall not rock during use. Bearing bars shall not be notched nor shimmed to maintain proper elevation or to eliminate rocking.

C. Grating shall not be field bent, cut, welded, or otherwise altered. Grating so altered will be considered defective.

D. Grating shall be removable unless noted otherwise. Grating that is indicated as being fastened shall be secured to frame or other supporting members as specified herein.

E. Platforms, landings, catwalks and walkways shall be fastened to supporting structure.

3.03 COATING REPAIR

A. Shop applied coatings which have been damaged shall be repaired with the same or equivalent materials used in original coating.

B. Repair of minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.

3.04 CLEANING

A. Grating shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

PART 4 SPECIAL PROVISIONS

4.01 FABRICATOR APPROVAL

A. The fabricator of structural load bearing members and assemblies furnished under this Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time that Shop Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

END OF SECTION

SECTION 05540
IRON CASTINGS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes manhole covers and frames, inlet grates and frames, stop plank grooves, and other iron castings shown on Drawings.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Product literature that shall be included; General Specifications, Surface Coating, Anchor Bolts, Machine Bearing Surface.

b. Independent Shop Drawings shall be submitted for the frame and the cover.

c. A submittal of a casting schedule that clearly notes either the structure number or in what circumstances the casting is intended to be installed, shall be included, i.e., roadway.

d. All dimensions for both the frame and the cover/grate shall be included.

2. Information for the Record:

a. Material certification.

b. Proof-load test data.

c. Manufacturer's installation instructions.

d. Manufacturing Capabilities and Quality Control Measures.

1.03 PRODUCT HANDLING

A. Castings shall be delivered in sufficient time to permit proper placement in pavement and slabs.

B. Castings shall be stored in such a way as to prevent warping prior to installation.

C. Additional product handling requirements are specified in Section 01350.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Castings shall be manufactured by East Jordan Iron Works, Inc., or equal.

2.02 MANHOLE COVER AND FRAME

A. Castings located in roadways, driveways, or other areas subject to vehicular traffic shall be suitable for heavy-duty service. Other castings shall be suitable for light-duty service.

B. Unless indicated otherwise, sewer manhole shall have a minimum access opening of 24 inches.

C. Unless indicated otherwise, heavy duty manhole cover and frame shall be East Jordan No. 1045, Product 00104510

2.03 INLET GRATE AND FRAME

A. Castings shall be suitable for heavy duty service.

B. Unless indicated otherwise, inlet grate and frame shall be East Jordan No. 7045.

2.04 RESERVED

2.05 PERFORMANCE REQUIREMENTS

A. Castings shall be gray iron conforming to ASTM A48, Class 35.

2.06 FABRICATION

A. Castings shall be free from pouring faults, sponginess, cracks, blowholes, blisters, shrinkage strains, and other defects. Plugging of defective castings is not permitted.

B. Castings shall be true to pattern in form and dimension. Weight of castings shall not vary by more than 5% from published weight. Contractor shall submit invoices showing actual weight of casting as certified by manufacturer.

C. Castings shall have machined bearing surfaces.

D. All castings shall be coated with a non-toxic, nonflammable, water-based, asphalt paint.

E. Lettering shall be cast on covers. Unless indicated otherwise, the manufacturer’s name shall be cast in cover.

F. Covers for water line manholes shall be solid lids and labeled “WATER”.

G. Covers for sanitary sewer manhole shall be solid lids and labeled “SANITARY”.

H. Covers for storm sewer manholes shall be labeled “STORM”.

I.

J. Covers shall be furnished with bolts, locks, hinges, perforations, lifting rings, and pick holes as specified, shown on Drawings, or as directed.

PART 3 EXECUTION

3.01 PREPARATION

A. Contractor shall examine surfaces to receive castings and shall report unacceptable conditions to Engineer before proceeding with the Work.

3.02 ERECTION AND INSTALLATION

A. Castings shall be accurately set, aligned, and anchored as shown on Drawings.

B. Castings shall be installed in accordance with manufacturer's instructions or shown on the drawings. If any discrepancies exist, then the more stringent requirements shall take precedence.

C. Stop plank grooves shall be square, set plumb, and securely anchored as shown. Grooves that are buckled, twisted, or otherwise prevent free insertion of stop plank shall be removed and replaced.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 05550
STAIR NOSINGS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes stair nosing for concrete, concrete filled metal pan and grating treads.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Product literature.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Nosings shall be stored in a manner to prevent bending or warping and shall be stored away from uncured concrete and masonry.

B. Factory applied protective tape shall not be damaged or removed before installation.

C. Material shall be delivered in sufficient time to permit proper placement in concrete.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Concrete Stairs:

1. Nosings shall be cast aluminum with aluminum oxide or silicon carbide abrasive integrally cast into walking surface.

2. Nosing shall be 4-inch wide and minimum of 5/16-inch thick. Nosing length shall be 6-inch less than length of step.

3. Cross hatching shall be minimum of 1/16-inch deep and shall be clean and well defined.

4. Anchors shall be of concealed type and integrally attached to nosing at 10-inch centers maximum. Exposed screws are not permitted.

5. Nosings shall have shot blasted finish.

6. Acceptable Products:
    a. Wooster Products Inc., Type 101.
    b. American Safety Tread Co., Inc., Type 801.
    c. Or equal.

B. Pan Stairs:
1. Nosing shall be extruded 6063-T5 or 6063-T6 aluminum with a continuous extruded anchor. Nosing shall be of barrier-free style.
2. Nosing shall have raised ribs composed of a mixture of virgin aluminum oxide, silicon carbide, and an epoxy binder. Ribs shall interlock with dove-tail grooves in extrusion. Color of ribs shall be as selected by Owner.
3. Nosing shall be 4-inch wide and minimum of 1/4-inch thick. Nosings shall be full length of steps less 1/8-inch clearance.
4. Acceptable Products:
    a. Wooster Products Inc, Type 241BF.
    b. American Safety Tread Co., Inc., Type 9711.
    c. Or equal.

C. Grating Stairs:
1. Nosing for aluminum grating treads shall be removable cast aluminum. Nosing for steel grating treads shall be removable cast iron. Grating landings shall have nosing at stair locations for the width of the stair treads. Landing Nosing shall extend 1” over top stair tread. All nosing shall have abrasive slip-resistant pattern on the exposed surface. Nosing shall be 1-1/4-inch wide. Radius of curvature of leading edge shall not exceed 1/2-inch.

2.02 FABRICATION

A. Nosings shall be accurately mitered as required to fit step.

B. Surfaces which will be in contact with concrete or dissimilar metal shall receive heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.

C. Walking surface shall be protected by factory applied protective tape. Tape shall not be removed until after installation is complete.

PART 3 EXECUTION

3.01 INSTALLATION

A. Nosings shall be installed in accordance with manufacturer's recommendations.

B. Damage to shop applied coating shall be repaired with same or equivalent material before nosing installation.

C. Nosings shall be installed as soon as possible after placement and consolidation of concrete. Nosings shall be installed before concrete has obtained initial set.

D. Concrete shall be puddled and nosing shall be tamped to ensure concrete is properly consolidated around anchors and under nosing.

E. Nosings shall be flush and level with the surrounding surface. Nosing shall be firmly anchored to concrete and shall not rock or bend.

3.02 CLEANING

A. Protective tape shall be removed as soon as practical after concreting but not before 24-hrs after completion of concrete placement.

B. When required, nosings shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 06630
MANHOLE STEPS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes manhole steps for new cast-in-place and existing structures.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's installation procedures.

b. Product literature.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Steps to be embedded in new structure shall be delivered in sufficient time to permit proper placement.

PART 2 PRODUCTS

4.01 MATERIALS

A. Manhole steps shall be polypropylene plastic reinforced with a 1/2-inch grade 60 reinforcing bar.

B. Manhole steps for new structures shall be M.A. Industries Model PS-1, or equal. Manhole steps for existing structures shall be M.A. Industries Model PS1-PF or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Contractor shall procure manhole steps in sufficient time for installation into precast and cast-in-place concrete structures.

3.02 PREPARATION

A. Existing structures shall be prepared as required by manufacturer.

3.03 INSTALLATION

A. Manhole steps shall be installed square, level, and plumb free of warp, twist, sag, and buckles.

B. Manhole steps in new concrete structures, whether precast or cast-in-place, shall be installed at time of casting.

C. Steps shall be installed in accordance with manufacturer's instructions.

D. Contractor shall reinstall all steps that do not meet the approval of the Owner and Engineer.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 07600
FLASHING AND SHEET METAL WORKS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing metal flashing, except through-wall flashing for masonry construction.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's product literature.

PART 2 PRODUCTS

2.01 ALUMINUM SHEET

A. Alloy and temper of sheet shall be 3003-H14.

B. Thickness of sheet shall be 0.032-inch.

C. Sheet shall conform to standards published by the Aluminum Association.

2.02 SPECIAL FINISHES

A. Anodic coating shall be Architectural Class I. Color will be selected by Owner.

B. Paint shall be a fluorocarbon coating containing polyvinylidene fluoride resin (Kynar® or equal). Color will be selected by Owner.

2.03 FASTENERS

A. Cleats shall be aluminum of same alloy, temper, and thickness of sheet being fastened, and shall not be less than 2-inch wide.

B. Nails shall be aluminum alloy 6061 conforming to FS FF-N-105B, Type II, Style 20.

C. Screws, bolts, nuts, and washers shall be aluminum alloy 6061-T6. Washers shall not be less than 0.040-inch thick.

2.04 FABRICATION

A. Flashing shall be formed of aluminum sheet not longer than 10 feet.

B. Mechanical seams and joints shall be flat-lap or lock seams. Seams and end joints shall not be riveted or fastened to restrict thermal movement. Sealant-filled controlled slip joints shall be used to allow thermal movement.

C. Brazing of aluminum sheet shall be permitted only under shop conditions. Filler alloy 4047 shall be used for brazing and flux residue shall be completely removed.

D. Field welding of aluminum sheet shall be permitted only when done with gas tungsten-arc (TIG) or gas metal-arc (MIG) welding processes. Filler alloy 4043 or 1100 shall be used.

E. Oxyfuel-gas welding of aluminum sheet shall be permitted only under shop conditions. Filler alloy 4043 or 1100 shall be used and flux residue shall be completely removed.

F. Soldering of aluminum shall not be permitted.

2.05 BITUMINOUS PAINT

A. Bituminous paint shall be of the cutback type conforming to Specification MIL-C B (1).

PART 3 EXECUTION

3.01 COORDINATION

A. Contractor shall examine the roofing manufacturer's details and coordinate Work between trades before sheet metal is installed.

3.02 PREPARATION

A. Surfaces receiving aluminum sheet shall be smooth, dry, and free of small projections and hollows.

B. Aluminum sheet surfaces to be in contact with concrete or masonry shall be coated with bituminous paint.

C. Anodizing shall be done subsequent to forming and fabricating.

3.03 INSTALLATION

A. Apron Flashing:

1. The ends of each length of apron flashing shall be lapped not less than 4-inch, or alternatively, a 2-inch sealant filled "S" lock shall be formed at one end of the flashing sheet to receive the end of the adjacent sheet.

2. Where sloping roof meets vertical wall, the flashing shall extend up the wall face not less than 4-inch and shall be counter-flashed. The flashing shall extend over the roofing not less than 5-inch. The lower edge shall be hemmed and secured by blind cleats spaced at 24-inch centers.

B. Valleys:

1. Valley sheets shall extend not less than 6-inch under the roof covering on each side of the valley, and side edges shall be folded 1/2-inch for cleating. Sheets shall lap not less than 6-inch in the direction of the flow and the upper edge shall be nailed to the roof deck. Side edges shall be secured and aluminum cleats spaced at 24-inch.

2. The open portion of the valley shall not be less than 5-inch in width at the top and increase in width 1/8-inch per foot toward the eaves.

3. Where intersecting roofs are on different slopes, an inverted “V” 1 1/2-inch high shall be formed in the metal along the center line of the valley and the lap of the valley sheets shall be increased to 8-inch.

C. Gravel Stops:

1. Gravel stop shall not be less than 1 1/2-inch high and the outer edge shall extend down not less than 4-inch to form a fascia. The horizontal flange shall extend onto the roof not less than 4-inch and shall be secured to wood nailer with aluminum nails spaced at 3-inch on centers.

2. The lower edge of the fascia shall be turned out 3/4-inch at an angle of 45 degrees to form a drip and shall hook 3/4-inch over a previously placed aluminum edge strip.

3. Edge strips shall be continuous with ends of adjacent lengths lapping not less than 1-inch. The lower edge shall be turned out 45 degrees to receive the drip edge of the fascia. Edge strips shall be fastened to wood with aluminum nails spaced at 4-inch, or to masonry with screws spaced at 10-inches.

4. Corner pieces shall be fabricated and mitered. End joints shall be made using a 12-inch long back-up plate and a 5-inch long top cover plate.

D. Counter Flashing:

1. Counter flashing shall be installed over base flashings where shown on the Drawings.

2. On masonry walls, the mortar joint to receive counter flashing shall be raked out to a depth of 1-inch. The counter flashing shall extend into the raked-out joint with the inner edge bent back to form a hook dam. The counter flashing shall be secured by aluminum wedges not more than 8-inch apart and the joint shall be filled with sealant, as specified in Section 07900.

3. The counter flashing shall overlap the base flashing by not less than 3-inch, and the ends of adjacent lengths shall overlap not less than 3-inch.

E. Coping Covers:

1. Flat seam cap flashing shall cover parapet walls and shall be joined by 1-inch loose lock seams filled with sealant. Walls shall have a continuous edge strip

along both sides secured to wood plate with aluminum nails spaced at 4-inch. The cap flashing shall be hooked over the edge strips with a 3/4-inch loose lock seam.

2. Corner pieces shall be shop fabricated and mitered.

F. Miscellaneous:

1. Scupper flashing shall cover the interior of the opening provided in wall and shall extend through and project outside of wall as shown on Drawings. Scupper box shall have continuous sides and shall be 1/2-inch smaller than the masonry opening. Flange on the roof side of the scupper box shall extend not less than 4-inch on all sides. Flange shall be continuous with rounded corners.

2. Aluminum cap flashing shall be provided for curbs, roof hatches, etc., as required by roofing manufacturer's details.

G. Drip edge, soffit, and fascia shall be installed where shown on the Drawings.

PART 4 SPECIAL PROVISIONS

4.01 SHEET METAL LOCATION

A. Sheet metal locations and installation details shall be per PEMB manufacturer.

B. Where specifically called out on drawings.

C. Where required to make waterproof envelope for building or equipment.

END OF SECTION

SECTION 07630
GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing gutters and downspouts.

B. All work performed under this Section shall comply with and be in accordance with all approved trade practices and manufacturers' recommendations.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's literature.

2. Information for the Record:

a. Samples as requested by Engineer.

PART 2 PRODUCTS

2.01 ALUMINUM GUTTERS AND DOWNSPOUTS

A. Aluminum gutter and downspout system shall meet the following thicknesses:

Gutters	0.032-inch
Downspouts	0.024-inch
Roof Apron	0.027-inch
End Caps	0.027-inch

B. Sealing material shall be Alcoa Gutterseal, Reynolds Aluminum, or equal.

C. Expansion joints shall be aluminum neoprene.

D. Downspout anchors shall be aluminum die casting and spaced no greater than 30 inches apart.

E. Finishes shall be baked enamel; color selected by the Owner from manufacturer's standards.

2.02 PVC GUTTERS AND DOWNSPOUTS

A. PVC gutter and downspout system shall be minimum schedule 40 per the International Building Code Chapter 15.

B. Joint sealant, hangers, supports, and expansion joints shall be per manufacturer's recommendations.

C. Fasteners shall be stainless steel.

D. Color shall be as selected by the Owner from manufacturer's standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be complete and in accordance with the manufacturer's recommendations, the Engineer's instructions, and the Contract Documents.

B. Gutters and downspouts shall be installed in accordance with the International Building Code Chapter 15 and the International Plumbing Code Chapter 11.

3.02 ALUMINUM INSTALLATION

A. Sealing joints and final cleaning shall be in accordance with Alcoa Architectural Aluminum Care During Construction, latest edition.

3.03 PVC INSTALLATION

A. Joints shall be cement welded per manufacturer's recommendations.

PART 4 SPECIAL PROVISIONS

4.01 GUTTER SCHEDULE

Gutter Size	Downspout Size	Material	Location
5"K – Style	3" x 4"	Aluminum	Biofilter Building

Note: Unless otherwise supplied by PEMB Manufacturer.

END OF SECTION

SECTION 07900
CAULKING AND SEALANTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes caulking and sealants.

1.02 SUBMITTALS

A. Submittal shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Contractor shall indicate variances from requirements of Contract Documents.

b. Product literature.

c. Manufacturer's standard color chart.

2. Information for the Record:

a. Manufacturer's surface preparation and installation instructions.

b. Written guarantee.

1.03 QUALITY ASSURANCE

A. Contractor shall have minimum of five years experience installing sealants.

1.04 GUARANTEES

A. Contractor shall guarantee sealant joints against adhesive and cohesive failure of sealant and against water penetration through joint for five years.

PART 2 PRODUCTS

2.01 CAULKING AND SEALANTS

A. Type A:

1. Sealant shall be two component polyurethane sealant, conforming to ASTM C920, Type M, Class 25, Type I, and either Grade NS or Grade P as appropriate. Sealant shall have Shore A hardness of 20-40 and minimum elongation of 500%.

2. Sealant shall be suitable for continuous immersion service in water and sewage.

3. Sealant shall be Sika Corporation “Sikaflex-2c NS/SL”, Polymeric Systems, Inc. “PSI 501/551”, or equal.

B. Type B:

1. Sealant shall be one component neutral or acetoxy cure silicone sealant conforming to ASTM C920, Type S, Class 25, Grade NS with Shore A hardness of 25-30.

C. Type C:

1. Sealant shall be one component, non-sag mildew resistant silicone sealant conforming to ASTM C920, Type S, Class 25, Grade NS, with Shore A hardness of 25-30.

D. Type D:

1. Sealant shall be one component acrylic latex caulk conforming to ASTM C834. Material shall be suitable for painting.

E. Type E:

1. Two component, coal-tar extended, fuel resistant polyurethane sealant conforming to ASTM C920, Type M, Class 25, Grade NS or Grade P as appropriate, with Shore A hardness of 15-35.

2.02 ACCESSORIES

A. Primer shall be sealant manufacturer’s recommended primer for intended substrates and intended service conditions. Primer shall be non-staining.

B. Backer rod shall be closed cell polyethylene or polyurethane as recommended by sealant manufacturer. Materials impregnated with oils, asphalt, or solvents are not acceptable. Backer rod shall be minimum of 33% oversized.

C. Bond breaker tape shall be polyethylene or similar type material which does not bond to sealant.

PART 3 EXECUTION

3.01 COORDINATION

A. Manufacturer’s recommendations for proper temperature and humidity conditions for installation shall be followed. Sealants shall not be installed when the ambient temperature is below 40 degrees F.

B. Substrate surface shall be inspected to ensure that no bond breaking materials contaminate surfaces to which sealant is to adhere.

C. Joint dimensions shall be verified prior to installing sealant to ensure that dimensions are within tolerances specified in sealant manufacturer’s literature.

3.02 PREPARATION

A. Surfaces shall be prepared in accordance with manufacturer's recommendations to ensure maximum adhesion. Surfaces shall be dry, sound, and free of oil, grease, dust, dirt, curing agents, temporary protective coatings, and other materials deleterious to bond.

B. Adjacent surfaces which are not to receive sealant shall be masked before primer and sealant is applied. Masking shall be removed immediately after sealant has been installed and tooled.

C. Primer shall be applied prior to installation of backer rod or bond breaker tape.

3.03 INSTALLATION

A. Backer rod shall be installed using only blunt or rounded tools designed to ensure uniform depth of backer rod without puncturing the material. Backer rod shall not be stretched, twisted or braided.

B. Where joint depth does not permit use of backer rod, bond breaker tape shall be installed to prevent three-sided adhesion.

C. Sealants shall be prepared, mixed, and installed in accordance with manufacturer's instructions using equipment recommended by sealant manufacturer. Sealant shall be installed as shown.

D. Sealants shall be tooled to uniformly smooth, slightly concave surface as shown on Drawings.

3.04 SCHEDULE

A. Unless shown or specified otherwise, sealant types shall be as follows:

Joint Type or Use	Sealant Type
Expansion joints, control joints, isolation joints, precast concrete joints.	A
Door, window, and other wall penetrations in exterior walls.	A
Joints in liquid-retaining structures	A
Structural or non-structural glazing	B
General building-interior use in bathrooms, kitchens, locker rooms, and other wet or humid areas.	C
General building use in areas other than those specified above.	D

B. Sealant color will be selected by the Owner.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 08125
HEAVY DUTY ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing heavy duty aluminum doors, frames, required fasteners, and other accessories required for completion of the Work.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Door Schedule.

b. Dimensional Drawing.

c. Manufacturer's literature.

d. Samples - When requested by the Engineer.

1) Samples of finish, frame corner construction, door construction, and glazing frame.

2) Samples shall be clearly identified as to location and type of finish.

PART 2 PRODUCTS

2.01 GENERAL

A. Aluminum doors shall be as manufactured by Cross Aluminum Products, or equal.

B. Products furnished for use in this Section shall be of one manufacturer unless specifically shown otherwise or approved by the Engineer.

2.02 DOORS

A. Door sections to be 1 3/4 '' x 4-inch tubular shapes of 6063-T5 alloy.

B. Joinery shall be steel tie rod bolted through stiles, where applicable a minimum of three 3/8-inch diameter cadmium plated steel rods a door.

C. The finish of doors and door parts shall be free of scratches, defects, die lines, and blemishes and shall have a natural anodized finish in conformance with AA Specification M12C22A41.

D. Minimum wall thickness 0.100-inch with 0.187-inch minimum at lock and hinge stiles.

E. Door sections are to interlock a minimum of 3/8-inch and form a 1/4-inch thick vertical reinforcement every 4 inches.

F. Exterior doors to be installed with urethane boardstock.

G. Glass stops to be extruded glazing channels, which are easily removed from the inside. Minimum wall thickness 0.080-inch.

H. Fluted No. 10 pattern extruded in door section.

I. Exterior doors shall be fully weather-stripped.

J. All double doors shall have a continuous astragal of the same material and color as the doors and installed on the exterior of the active leaf to cover the gap between doors.

K. Each door shall have non-ferrous lever handles in place of knobs on the passing slide of the astragal or as called for on the hardware schedule. The assembly shall contain a booster spring to ensure the lever returning to a horizontal position.

2.03 ALUMINUM FRAMES

A. All sections of frames shall be fabricated from aluminum alloy 6063 and T-6 temper with a minimum thickness of 0.125-inch. Screws shall be 18-8 stainless steel.

B. All framing members shall be accurately milled with flush hairline joints. Frames shall be closed back or open back as detailed on the Drawings.

C. Door frame corner members shall be heavily reinforced with channel type corner gussets fastened with concealed stainless-steel screws.

D. Frames shall be reinforced in the areas to receive locks, hinges, and door closers.

E. Door frame finish shall match that of the door. The finished product shall be free of scratches, defects, and blemishes.

F. Door stops shall be attached to the frame with concealed fastenings with vinyl inserts for weatherproofing and silencing.

PART 3 EXECUTION

3.01 DELIVERY, HANDLING, AND STORAGE

A. Delivery, handling, and storage shall be in accordance with the requirements of Section 01350.

3.02 INSTALLATION OF FRAMES

A. Set frames to maintain scheduled dimensions, hold head level, and set jambs plumb and square.

B. Secure anchorages and provide connections to adjacent construction.

C. Apply protective coating of bituminous paint to backs of frame to separate aluminum from contact with masonry, concrete, or other galvanically incompatible materials.

D. Frame shall be set with a minimum of eight anchors.

3.03 INSTALLATION OF DOORS

A. Comply with manufacturer's instructions for installation of door hardware, operators, and other components.

B. Adjust hinges so doors operate smoothly and fit properly when closed.

C. Adjust and lubricate locks, operators, and hinges.

D. Clean aluminum surfaces and remove protective tape and excess caulking sealants.

E. Thresholds are to be provided at exterior doors. Bottom, head, and jamb weather-strips shall be adjusted to fit correctly.

PART 4 SPECIAL PROVISIONS

4.01 BUILDING (4 REQUIRED)

A. The Contractor shall furnish and install four heavy duty aluminum doors.

B. Doors shall have a maximum U value of 0.200.

4.02 GLAZING

A. Quality of Glass:

1. All glass shall be of the best grade of its respective kind and shall be free from flaws of any sort. All glass shall be of new material, as manufactured by Pittsburgh Glass Co., Libbey-Owens-Ford Co., Mississippi Glass Co., or equal.

2. Each piece of glass shall bear the manufacturer's label giving the name of the manufacturer and the quality of the glass, including its weight or thickness. Absence of label will constitute cause for rejection.

3. All glazing and glazing materials shall comply with the requirements of the safety standard for Architectural Glazing Materials issued by the Consumer Product Safety Commission.

B. Safety Glass:

1. The doors will receive 1-inch tempered safety glass. Glass shall be metal banded insulating units. Glass stops in the doors are to be extruded with minimum wall thickness of 0.125 inch and will be easily removed from the inside.

C. Installation:

1. Provide sufficient clearance around edges of all glass to allow for expansion and contraction, vibration, and adjustment. Glazing beads and stops will be provided and fitted by the Contractor. They shall be set tight but shall not bind the glass.

2. All glass set in Neoprene Structural Gaskets shall be installed by the Contractor with neoprene setting blocks and lock strips furnished by structural gasket manufacturer.

3. All glass where compounds are required shall be bedded with resilient setting blocks and set with an elastic glazing compound as manufactured by A.C. Horn Co. “Vulcatex”; Sonneborn Chemical and Refining Co. “Kaukit”; Euclid Chemical Co. “Eucalk”; or equal. Compound shall conform to Federal Specification TT-C598, Grade 1.

4. The exterior side of insulating glass in gaskets shall be sealed with A.C. Horn Co. “Hornflex” Thiokol LP-32 Sealant, Sonneborn Chemical and Refining Co. “Sonolastic Sealant,” or equal. Compound shall conform to ANSI A-116.1 for polysulfide base sealing compounds, or as required by the glass manufacturer.

D. Breakage and Cleaning:

1. The Contractor shall replace all lights of glass damaged during construction and shall deliver buildings to the Owner with all lights in like-new condition.

2. On completion of work, the Contractor shall thoroughly clean all glass of dirt, paint, and stain and remove glazing compound from adjoining work.

END OF SECTION

SECTION 08310
OVERHEAD AND VERTICAL LIFT DOORS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing of overhead doors as scheduled on the Drawings and specified herein.

B. The Contractor shall perform all preparatory Work and provide all necessary components for a complete installation.

C. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Door Schedule.

c. Dimensional Drawing.

d. Manufacturer's Literature.

e. Electric Operated Doors:

1) Motor information per Section 11050.

2) Wiring schematic.

3) Controls catalog data.

2. Operation and maintenance manual.

PART 2 PRODUCTS

2.01 STEEL DOORS

A. Unless otherwise noted, overhead steel doors shall be Model 596 "Thermacore" upward-acting sectional doors as manufactured by the Overhead Door Corporation, or equal.

B. The door shall be made of not less than 20-gauge steel exterior panels and 24-gauge steel interior panels joined together to form a door of not less than 2-inch thickness with flush face on both sides. The steel shall be galvanized with not less than 1.25-ounce

zinc per square feet, and chemically treated for paint adherence. Steel shall be roll-formed. Doors shall be insulated with CFC-free polyurethane.

C. Meeting rails shall be tongue and groove or rabbeted-type weathertight joints and act as two interlocking struts for the full length of all sections of the door.

D. The bottom section of all doors shall have a replaceable U-shaped PVC, vinyl, rubber, or neoprene weather seal. Doors shall be equipped with a bottom sensing edge.

E. The top section and jambs of all doors shall have replaceable PVC, vinyl, or neoprene weather seal strips.

F. The doors shall be counterbalanced by 25,000 cycle torsional springs on a continuous, ball bearing supported, head shaft; cast aluminum tapered drums, and galvanized steel aircraft type lift cables.

G. The doors shall be equipped with a wedge type opening and closing action.

H. Tracks shall be minimum 14-gauge galvanized steel and have a graduated seal for weathertight closing.

I. All hinges and brackets shall be minimum 14-gauge galvanized steel. Rollers shall have one-piece steel tires with ball bearings running in case hardened races.

J. Doors shall have a factory-applied baked-on enamel or polyester finish. Color shall be selected by the Owner from manufacturer's standard colors.

K. Overhead steel doors shall be electric operated per section 2.03.

L. Rollers shall have one-piece steel tires with ball bearings running in case hardened races.

M. Partial glazing shall be full-view, full-width aluminum sash section supplied with insulated double strength thermal glazing.

N. Door manufacturer shall offer a 10-year warranty against panel delamination of foam and steel skins.

2.02 RESERVED

2.03 ELECTRIC OPERATORS

A. Each door shall be automatically operated by an electric operator.

B. Electric operator shall be designed for continuous, heavy-duty use.

C. Each motor shall be 1 hp and operate on 120-volt, single phase, 60 Hz electric power. It shall be totally enclosed, instant reversing with built-in inherent overload. It shall be instant reversing with built-in inherent overload. Motors shall be UL listed and shall move door in either direction at not less than 2/3 foot per second nor more than 1 foot per second. Operator shall meet UL325, 2010 requirements for continuous monitoring of safety devices.

D. Operator shall be side-mount type, connected to the crosshead shaft with an adjustable coupling or drive chain sprocket.

E. Each door shall be supplied with a control panel that contains a reversing starter, control transformer, and all other components required for proper operation connected to a terminal strip. Also supplied with each door shall be a fused disconnect and an OPEN/ CLOSE/STOP pushbutton station shipped loose with each door operator. All enclosures shall be NEMA 4X unless otherwise noted on the Drawings.

F. The speed reducer shall be worm and gear type coupled to the motor by a flexible coupling. Shafts shall rotate on ball bearings.

G. A positive gear type limit switch shall be mounted on the operator frame with easily accessible and adjustable switches to control open and closed limits of door travel. They shall be totally enclosed in metal box and always “in-time” when motor is engaged.

H. A standard double shoe type brake shall be mounted on the speed reducer input shaft, independent solenoid actuated, controlled by the motor starter. It shall stop and hold the door in any position.

I. The bottom section of all doors shall have an electrical safety strip. The device operates in conjunction with the door operator control to stop and reverse the door to the open position if an obstruction is encountered while closing.

J. An emergency hand chain operator shall be provided to operate the door in case of power failure.

K. Electric operator systems shall be explosion and dust ignition-proof.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle overhead doors in accordance with the requirements of Section 01350.

3.02 INSTALLATION OF FRAMES

A. Set frames to maintain scheduled dimensions, hold head level, and set jambs plumb and square.

B. Secure anchorages and provide connections to adjacent construction.

3.03 INSTALLATION OF DOORS

A. Comply with manufacturer’s instructions for installation of door hardware, operators, and other components.

B. Adjust so doors operate smoothly and fit properly when closed.

C. Adjust and lubricate locks and operators.

D. Clean surfaces and remove protective tape and excess caulking sealants.

PART 4 SPECIAL PROVISIONS

4.01 BLOWER BUILDING (4 REQUIRED)

A. The Contractor shall furnish and install four electrically operated overhead doors in the Blower Building.

B. Overhead doors shall have a maximum U value of 0.57.

C. Door details can be found on the door schedule on the Drawings.

4.02 OPERATING FOBS

A. The Contractor shall furnish two remote operating fobs for each overhead door as part of the contract.

END OF SECTION

SECTION 08315
ROLL-UP DOORS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing of roll-up doors complete and ready for service as shown on the Drawings and described in this Section.

B. Each roll-up door shall be furnished complete with a curtain, hood, guides, gears, motor operator, weather-stripping, safety strip, and all other accessories required for satisfactory operation.

C. The erector of the doors shall be approved by the manufacturer.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Door Schedule.

c. Dimensional Drawing.

d. Manufacturer's literature.

e. Electric Operated Doors:

1) Motor information per Section 11050.

2) Wiring schematic.

3) Controls catalog data.

2. Operation and maintenance manual.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General - The dimensions of the roll-up doors shall be as shown on the Drawings and as called for in the door schedule. The doors, frames, and operators shall be products of Overhead Door Corp., or equal. Door shall be the Model 625 with double interlocking slats and foam insulation.

B. Doors:

1. The door curtain shall be of interlocking slats formed in easy curves without sharp bends. The slats shall be flat profile and shall be insulated. The front of the slat shall be 0.040-inch-thick aluminum while the back of the slat shall be 0.024-inch-thick aluminum.
2. Slats shall be of sufficient section to provide curtain strength adequate to safely resist a wind load of 20 pounds per square feet.
3. Insulation shall be CFC-free polyurethane providing a minimum R value of 10.9.
4. Ends of slats shall be provided with end locks with integral slat lugs as wind locks which engage bars and lock the curtain in the guides. Bottom bar shall be two aluminum angles.
5. The curtain shall be coiled in a hood, minimum 24-gauge galvanized steel, on a pipe or barrel of size sufficient to carry the door load, with a deflection not to exceed 0.03 inch per feet of opening width. The door shall be evenly counterbalanced by helical springs contained in pipe. All springs shall be anchored to the same tension rod and held in position by the same adjusting wheel accessible from the outside.
6. The coil brackets shall be of high grade iron or precision formed steel plate designed to house the ends of the coils and support the counterbalance assembly.
7. The gears shall be high grade gray iron, cast teeth machine molded from machine-cut patterns.
8. The guides shall be built of structural aluminum angles to form a slot of sufficient depth to retain curtain in guides against heavy wind pressure. Guides shall be provided with wind lock bars.
9. Guides and hood shall be weather-stripped to prevent air passage.
10. Doors shall be equipped with vinyl or neoprene seals to close the void between the door and head.
11. Coating shall be SpectraShield Zirconium treatment followed by baked-on polyester powder coat. Color as selected by City from manufacturer's standard color range.
12. Doors shall be warranted for 3 years or 20,000 cycles on both door an operator, for normal use of up to 20 cycles per day maximum.
13. Weatherstripping:
    a. Bottom Bar: Sensing/weather edge with neoprene astragal extending full width of door.
    b. Guides**:** Replaceable vinyl strip on guides sealing against fascia side of curtain.

c. Lintel Seal: Nylon brush seal fitted at door header to impede air flow.

C. Electric Operators:

1. The electrically operated roll-up doors shall be provided with a compact unit designed and built by the door manufacturer, requiring a minimum side clearance.

2. The motor to be high starting torque having sufficient power to operate door at an approximate average speed of 1-foot per second. The electrical supply to the motor will be 120/1/60. Motor shall be ¾ horsepower.

3. Adjustable screw-type limit switches which will break the circuit at the termination of travel.

4. High efficiency worm gearing, running in an oil bath, should be furnished together with a spring-set solenoid operated brake completely housed to protect against damage, dust.

5. An emergency hand-chain operator which does not affect the timing of the limit switch shall be provided to operate the door in case of power failure.

6. The operator shall be designed to transmit motion to the door without shock and automatically release motor from driving unit prior to stalling, so as to prevent any damage to unit from any type of overload. An efficient overload protective device, which will break the power circuit and protect against damage to motor windings, shall be both heat and current sensing, and installed integral with the unit.

7. Each door shall be supplied with a control panel that contains a reversing starter, control transformer, and all operating components connected to a terminal strip. Also supplied with each door shall be a fused disconnect and an “open/close/stop” pushbutton station shipped loose with each door operator. All enclosures shall be NEMA 4X unless otherwise noted on the Drawings.

8. Unless otherwise noted on the Drawings or in the Door Schedule, the Contractor shall provide a combination compressible weather seal and an electrical safety strip mounted along the bottom edge of each motor operated door. The device shall operate in conjunction with the door operator control to stop and reverse the door to the open position if an obstruction is encountered while closing.

9. Door fobs (Qty 2) shall be supplied by the door manufacturer and programmed to work with the door operator.

10. Control Station, Surface mounted: "Open/Close/Stop" push buttons, NEMA 4X rated shall be provided.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle roll-up doors in accordance with the requirements of Section 01350.

3.02 INSTALLATION OF FRAMES

A. Set frames to maintain scheduled dimensions, hold head level, and set jambs plumb and square.

B. Secure anchorages and provide connections to adjacent construction.

3.03 INSTALLATION OF DOORS

A. Comply with manufacturer's instructions for installation of door hardware, operator, and other components. The installation shall include conduit and wire per Division 16, required to connect the pushbutton station, disconnect switch, and safety strip to the control panel.

B. Adjust so doors operate smoothly and fit properly when closed.

C. Adjust and lubricate locks and operators.

D. Clean surfaces and remove protective tape and excess caulking sealants.

PART 4 SPECIAL PROVISIONS

4.01 BIOFILTER BLOWER BUILDING

A. The Contractor shall furnish and install one electrically operated roll up door.

B. A door schedule is provided on the Drawings.

4.02 OPERATING FOBS

A. The Contractor shall furnish two remote operating fobs for each roll-up door as part of the contract.

END OF SECTION

SECTION 08700
FINISH HARDWARE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all hardware necessary to operate the doors scheduled or shown on the Drawings.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Hardware schedule.

c. Key schedule.

d. Manufacturer's literature.

e. Manufacturer's warranty.

1.03 MANUFACTURER'S WARRANTY

A. A two-year guarantee shall be provided by the hardware manufacturer on the workmanship and materials for door closers, lock sets, door handles, and exit devices.

B. All other hardware items are subject to one year's guarantee requirements from the date of final acceptance.

C. The provisions of these warranties shall not be construed as relieving or reducing the obligations of the Contractor outlined in the General Conditions of these Specifications.

1.04 QUALITY ASSURANCE

A. Hardware shall be a standard product of one of the following manufacturers or equal.

Item	Manufacturer
Hinges, Pulls, Push Plates	Stanley, Sargent, or equal
Locks, Closers, Dead Bolts	Yale, Corbin, Russwin, or equal
Thresholds	Zero, National Guard, or equal
Weather-stripping	Zero, Tremco, National Guard, or equal
Flush Bolts	Ives, Stanley, Corbin, Glyn Johnson, or equal

PART 2 PRODUCTS

2.01 GENERAL

A. All hardware shall be made of stainless steel or bronze with finish as scheduled. Concealed parts of hardware shall be of nonferrous metal unless otherwise specified.

B. All door closers shall have cast iron bodies with scheduled finish and of proper size for the doors on which they will be mounted. Door closers shall be applied indoors and equipped with brackets if necessary. All door closers shall have hold-open features unless otherwise indicated or required.

C. All hardware (for each opening) shall be delivered to the building site separately wrapped and packaged with the correct screws and bolts for installation. Each package shall be properly labeled with location numbers corresponding with the hardware schedule.

D. Each package of finish hardware shall include all screws, strikes, plates, knobs, roses, and other items required for complete and finished installation.

E. All double doors shall have nonferrous lever handles in place of knobs on the passing side of the astragal. The assembly shall contain a booster spring to ensure the lever returning to a horizontal position.

2.02 TEMPLATES

A. Furnish and deliver directly to the metal door manufacturer templates of all hardware to be applied to doors and frames.

2.03 KEYS AND KEYING

A. Locks shall be heavy duty. Each cylinder shall have six pin tumblers. Strikes shall be of the box type.

B. Locks shall be master keyed to existing doors according to instructions provided by the Owner.

C. Submit keying schedule to Engineer and Owner for approval (including an explanation of the keying system).

D. Four keys shall be furnished for each lock.

2.04 PANIC GUARD EXIT DEVICE

A. Panic Exit Device shall include as an integral part of the device a retractable deadlocking bar mechanism which provides a continuous barrier at the meeting stiles. The device shall not require additional mullions, coordinators, timing devices, etc., to allow proper door function.

B. Panic Exit Device shall have the capability of being dogged in the unlocked position by a single turn of the cylinder key.

C. Meeting stiles shall be designed and constructed to house and conceal all mechanical components and provide a smooth, uncluttered appearance. No exposed screws or fasteners shall occur on the exterior surface of the door stiles.

D. "Panic Guard" Exit Device shall be installed by the manufacturer at the factory before shipment is made. Device shall be listed by UL.

PART 3 EXECUTION

3.01 HARDWARE INSTALLATION

A. Finish hardware shall be applied in a workmanlike manner. All butts shall be of uniform spacing and the leaves so set as to avoid screw holes penetrating the face of the door. Locks shall be set level and with true back sets. The striking plates, opposite same, shall be in exact alignment with latches and bolts.

B. Upon completion, the Contractor shall check all hardware, fit all keys in their respective locks, and deliver all keys properly tagged to the Owner. Delivery of the keys shall not constitute acceptance of the building.

PART 4 SPECIAL PROVISIONS

4.01 HARDWARE SCHEDULE

A. The manufacturers' names and catalog numbers shown on this schedule have been used as a guide to type, style, and materials of construction only. Other manufacturers of the hardware are noted in Subsection 1.04 of this Section.

B. The hardware schedule does not necessarily include all the hardware for all the buildings.

C. The Contractor shall furnish all hardware of whatever nature as necessary to complete the buildings whether or not shown on this hardware schedule.

D. Hardware Schedule:

1. Type 1:

Part		Finish	Per door
Butts	Stanley FBB199, 4-1/2 x 4-1/2	32D	1-1/2 pair
Lockset	Adams Rite 4710	32D	1
Lever entry trim	Adams Rite Tubular 3082	32D	1
Panic exit device	Adams Rite 8400 w/standard box strike	32D	1
Mortise cylinder			1
Closer	Yale 2314 BC	32D	1
Door bottom seals	National Guard 200NA		1
Threshold	National Guard ADA 613		1
Kickplate	10-inch by 34-inch	32D	1

2. Type 2:

Part		**Finish**	**Per door**
Butts	Stanley FBB199, 4-1/2 x 4-1/2	32D	1-1/2 pair
Lockset	Adams Rite 4710	32D	1
Lever entry trim	Adams Rite Tubular 3082	32D	1
Panic exit device	Adams Rite 8400 w/standard box strike	32D	1
Pair flush bolt	Adams Rite Tubular FB-14	32D	1
Mortise cylinder			1
Closer	Yale 2314 BC	32D	1
Weatherstripping	National Guard 160SA		1 set
Door bottom seals	National Guard 200NA		1
Threshold	National Guard ADA 613		1
Kickplate	10-inch by 34-inch	32D	1

END OF SECTION

SECTION 09900
PAINTING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and application of protective coatings to all wood, concrete, and metal surfaces as specified or as shown on the Drawings.

B. Included in this Section is surface preparation, shop application inspection, and field touch up work as required to provide a complete protective coating system.

C. In general, the Work shall include the field painting of the following:

1. All exposed interior cast-in-place concrete (except floors) above ground floor.
2. All exposed concrete blocks and hollow core precast slabs.
3. All exposed plaster.
4. All exposed wood.
5. All exposed pipe insulation.
6. All exposed piping, including fittings, valves, couplings, flanges, and other in-line accessories.
7. All exposed conduit.
8. All machinery, pumps, and equipment.
    a. Nonferrous equipment shall not be painted.
9. All metal surfaces except the following:
    a. Bronze surfaces.
    b. Stainless steel surfaces.
    c. Aluminum or galvanized steel not requiring color coding or otherwise specified to be coated.

D. Additional product requirements are specified in Section 01350.

E. A Coating Schedule appears in Part 4 of this Section.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. Coating manufacturer’s product data and technical literature including:

1) Catalog number.
2) General classification.
3) Coating material analysis.
4) Detailed surface preparation guidelines.
5) Mixing, thinning, and application instructions for each material.
6) Induction time, pot life, viscosity, and drying and curing times for acceptable ranges of temperature and humidity.

b. Abrasive manufacturer's information including:

1) Name, address, and phone number of manufacturer and local supplier.
2) Bulk density.
3) Mohs ranking.
4) Sieve analysis.
5) Chemical analysis including impurities.
6) Free silica content.
7) Grain shape (roundness).

c. Submittals of coatings by a manufacturer not named in these specifications shall include performance criteria on abrasion, adhesion, exterior exposure, hardness, humidity exposure, salt spray (fog), impact, immersion, etc., as applicable, per the appropriate ASTM standards. If requested by the Engineer, the Contractor shall submit manufacturers complete formula for the coatings which are proposed to be furnished. The Engineer may also require the submission, at the Contractor's expense, of test reports from private laboratories showing results of comparable tests on the coatings proposed and the coatings specified.

d. Details of application equipment and procedures.

e. Samples of manufacturer's standard colors.

2. Information for the Record:

a. Certification that materials meet or exceed Specifications and that coating systems are suitable for intended use.

b. Certification that coating systems are compatible with substrate, specified surface preparation, prime coats, sealants and existing finishes.

c. Safety Data Sheets (SDS) for coating materials, thinners, diluents, abrasives, cleansers, and other materials.

d. Schedule of coating work showing each phase and step of Work.

1.03 QUALITY ASSURANCE

A. Standards - Surface preparation, coating, and patching work performed under this Section shall conform to the applicable provisions and recommendations of the following standards.

1. SSPC Steel Structures Painting Manual, Volume 1, “Good Painting Practice.”
2. SSPC Steel Structures Painting Manual, Volume 2, “Systems and Specifications.”
3. SSPC Vis. 1 and 2, visual standards and written guidelines.
4. NACE Coatings and Linings Handbook.
5. Applicable NACE standards and recommended practices including RP0178 and RP0184.

B. Field Mock-ups - Where specified in the Coating Schedule, a field mock-up shall be done prior to performing the required Work.

1. Field mock-ups shall be a minimum of 4 square feet in area, in a location chosen by the Owner or his representative.
2. The mock-ups will serve as a standard of acceptance for applicable coating work under this Contract.
3. The coating manufacturer’s representative will be available to advise the Contractor.
4. Step-down mock-ups, showing the prepared substrate, primer, intermediate, and finish coats, as applicable, shall be used. Where the substrate is a ferrous metal, the portion remaining exposed shall be protected with a clear varnish.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section 01350.

B. Include the following information on container labels or packing slips:

1. Manufacturer’s name.
2. Name or title of material.
3. Batch numbers.
4. Stock number and date of manufacture.
5. Shelf life or expiration date.
6. Contents by volume of pigment, binder, and vehicle.
7. Thinning instructions when recommended.

8. Application instructions.
9. Color name and number.
10. Safety Data Sheets (SDS).

C. Provide controlled storage for coating materials and abrasives. Store coating materials in environmentally controlled enclosure with minimum ambient temperature of 55 degrees F. Store abrasives in dry area.

D. Maintain inventory of coating materials, solvents, and cleaners.

1.05 SCHEDULING AND SEQUENCING

A. Notify Engineer two weeks in advance of surface preparation and coating application.

B. Work systematically in accordance with submitted schedule.

C. Sequence and coordinate abrasive blasting and coating application with Work of other sections. Do not interrupt plant process or interfere with Owner's operations.

D. Coordinate coating work with installation of sealants specified in Section 07900.

1.06 MANUFACTURER'S RECOMMENDATIONS

A. Apply coatings in strict compliance with manufacturer's recommendations and instructions as to environmental conditions, surface preparation, mixing, application, and curing. Where Specifications are more stringent than manufacturer's recommendations, Specifications shall prevail.

B. Resolve conflicts between Specifications and manufacturer's recommendations and instructions by obtaining written agreement between Engineer and coating manufacturer prior to beginning Work.

1.07 DESCRIPTION

A. Shop Painting - Shop painting shall be performed to the extent and as required under Section 01350 and the various individual sections of the specifications. All metal surfaces shall be given a protective shop coat of primer compatible with the field coating. Shop primer color shall be beige where available. If a prime coat has not been applied in the shop, then a prime coat shall be applied in the field after proper surface preparation and prior to the application of the finish coats.

B. Compatibility - The Contractor shall ensure the primer or finish coating applied in the shop is compatible with the specified field coatings. If the coatings are incompatible, the shop coatings shall be removed by abrasive blasting and coatings applied in conformance with this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. The products shall be as specified in the Coating Schedule. Materials selected for each coating system shall be the product of one manufacturer. The Contractor shall be responsible for the compatibility of all components of each coating system including primer, thinner, and solvents.

2.02 COATING SCHEDULE

A. The Coating Schedule included in Part 4 of this Section identifies the areas to be painted, the required materials, and number of coats required.

PART 3 EXECUTION

3.01 ENVIRONMENTAL REQUIREMENTS

A. Environmental Conditions:

1. Perform Work of this Section under the following environmental conditions.

   a. Abrasive blast only when surface contamination can be prevented. Abrasive blast only when surface temperature is more than 5 degrees F above dew point and relative humidity is less than 85%.

   b. No coating shall be applied when the air temperature, as measured in the shade, is below 40 degrees F or above 90 degrees F. No coating shall be applied when the temperature of the surface to be painted is below 35 degrees F or as recommended by the paint manufacturer, whichever is greater. Coatings shall not be applied to wet or damp surfaces, when the relative humidity exceeds 85%, or when the surface to be painted is less than 5 degrees F above the dew point.

2. Coating work may proceed during inclement weather in environmentally controlled enclosures. Environment within enclosure shall comply with Specifications and manufacturer's recommendations. Provide adequate ventilation and illumination. Minimum illumination shall be 150-foot candles.

B. Interior Painting may be done only when the building has been thoroughly dried, by natural or artificial heat, and when the Work area is properly heated and ventilated, clean, and as nearly dust free as possible. Room temperature shall be maintained within the manufacturer's recommendations during application and until coatings are dry.

C. Dust - Coating shall not be applied in areas where dust is being generated.

3.02 PROTECTION

A. During the construction period, all electrical and mechanical equipment and other equipment and apparatus shall be protected from paint drippings by means of tarpaulins, burlap, wooden housings, or other protection.

B. Finished work of other trades, surfaces not being painted concurrently or not to be painted, and factory finished lockers, toilet partitions, etc., that will not require field painting shall be protected at all times from paint spots and damage to the finish.

C. Perform cleaning and coating operation in manner which prevents dust and contaminants from falling in newly applied coating.

D. Protect portions of Work which are partially or entirely completed and which are adjacent to surfaces being prepared by abrasive blasting.

E. Protect completed Work from solvents, contaminants, or other substances which may damage coating.

F. Prominently display “Wet Paint” signs in sufficient number to protect newly applied coating.

3.03 PREPARATION OF SURFACES

A. General - All surfaces, of whatever material, which are to be painted shall be thoroughly cleaned of dirt, grease, rust scale, or other injurious substance, and, at the time of application of the coating, shall be clean and dry.

B. Metal Surfaces:

1. Remove weld spatter and other projections. Grind sharp edges to a minimum radius of 1/8-inch. Grind rough welds smooth. Grinding shall be in accordance with SSPC Surface Preparation Commentary. Surfaces shall be smooth and contoured in compliance with SSPC-SP 12.

2. Surfaces which have not been shop coated shall be abrasive blasted prior to any prime coats. Abrasive blasting shall be done in accordance with the Coating Schedule.

3. Shop primed surfaces shall receive a field sweep blast prior to the application of subsequent coats.

4. Abrasions or defects on shop coated surfaces shall be spot primed.

5. Surfaces which are to receive a high heat coating shall be Near White Blast Cleaned (SSPC, SP-10) and painted within eight hours; or, if recommended by the manufacturer of the approved high heat coating, the surfaces may be thoroughly cleaned to bare metal and given wash coats or a cold phosphatizing treatment as recommended by the manufacturer and as approved by the Engineer.

C. Concrete and Masonry Surfaces:

1. New concrete and masonry surfaces shall be allowed to become completely cured for at least 30 days at a temperature of 75 degrees F and, immediately prior to treatment, shall be thoroughly cleaned of all dirt, grease, form release agents and stains. Curing compounds shall be removed.
2. Concrete surfaces shall be pressure washed with solution of trisodium phosphate (4 ounce per gallon) and detergent in hot water. Water temperature shall be approximately 180 degrees F. Immediately flush surface with clean potable water until pH of surface meets acceptance criteria of ASTM D4262.
3. If recommended by the coating manufacturer, on concrete surfaces less than six months old, one coat of zinc sulfate solution shall be uniformly applied and allowed to dry before application of the coating.
4. Concrete surfaces shall be abrasive blasted with coarse, hard, and angular abrasive after cleaning. Air stream shall be free of moisture and oil.
5. Acid etching is not permitted.

D. Wood Surfaces shall be sanded smooth and filled with an approved paste or liquid grain filler, and cracks and crevices shall be filled with a non-shrinking, elastic composition especially prepared for this purpose. Wood surfaces to be varnished shall be rubbed smooth with pumice and oil.

E. Clean up all debris from the surface preparation operation.

3.04 ABRASIVE BLASTING

A. Abrasives shall be expendable coal slag or aluminum oxide, free of silica, or a steel shot/grit mixture. Maintain abrasives free from dust, salts, and other impurities. Select the type and size of abrasive to yield a surface as specified in the Coatings Schedule.

B. Provide moisture and oil separators or traps of adequate size in compressed air system to provide dry and clean air supply. Drain traps automatically during blasting operation. Remove oil and moisture accumulated in air receiver by regular purging.

C. Remove weld splatter, slivers, laminations, and underlying mill scale which become visible after abrasive blasting, by grinding in accordance SSPC SP-3 and NACE RP0178. Follow grinding by final abrasive blast.

D. Surfaces which cannot be properly cleaned by abrasive blasting because of their location may be prepared by power tool cleaning in accordance with SSPC SP-11 (Power Tool Clean to Bare Metal) in lieu of abrasive blasting, subject to Engineer's approval.

E. After surface preparation but prior to priming inspect surface for corrosion. Remove corrosion products which become visible when viewed without magnification by re-blasting.

F. Remove dust and blasting residue by blowing with clean, dry air, and vacuum cleaning with clean tools.

3.05 MIXING AND THINNING

A. All mixing shall be performed by mechanical paint shakers or mixers in strict accordance with the manufacturer's printed instructions.

B. Do not use coating material which has livered, gelled, or otherwise deteriorated during storage. Thixotropic materials which obtain normal consistency when stirred are acceptable. Where a skin has formed in container, cut skin loose from sides of container and discard prior to mixing.

C. Each component of multi-component materials shall be mixed individually before use. The material shall be mixed in a manner which will insure the break-up of all lumps, complete dispersion of pigment, and a uniform composition. Materials shall be inspected after mixing for uniformity and to verify that no unmixed pigment remains at the bottom of the container.

D. The individual parts shall be mixed together in the proportions recommended by the manufacturer. The materials shall be mixed thoroughly before use and shall be agitated often enough during application to ensure a uniform composition.

E. Mixed coatings shall be strained after mixing unless the application equipment is provided with strainers. Strainers shall be of a type to remove skins and undesirable matter without removing pigment.

F. Thinner shall not be added unless required for proper application. Thinning shall be in strict accordance with the manufacturer's recommendations.

G. Mixed coatings shall have pot life stated on label and indicated in approved Shop Drawing. When pot life limit is reached, discard material, clean equipment, and mix and induct new material.

H. Store materials not in actual use in tightly covered containers. Maintain containers and equipment used in storage, mixing, and application in clean condition, free of foreign materials and residue.

3.06 COATING APPLICATION

A. Apply prime coat within eight hours of completion of surface preparation. If surface is degraded, contaminated, or wet by rain or moisture subsequent to surface preparation and prior to coating, restore surface in accordance with Specifications.

B. Prior to applying each coat, remove dust with industrial vacuum cleaner using new filters, clean tools, and clean hopper. Remove residue or foreign matter on coating before applying additional coats by pressure rinsing with 1800-2000 psi water, when required by Engineer's representative.

C. Apply coatings in accordance with applicable provisions of SSPC Paint Application Specification PA 1. Use equipment best suited for the coating material.

D. Cloudiness, spotting, laps, brush marks, roller marks, runs, sags, drips, ropiness, voids, discontinuities, pinholes, and other surface imperfections are unacceptable.

E. When spray application is approved by Engineer. Spare fittings, gun tips, gun parts, and other spray equipment shall be acceptable to Engineer.

F. Stripe coat edges, welds, corners, crevices, and other surfaces difficult to coat before applying full coat in accordance with SSPC-PA 1.

G. Coverage shall be in conformance with the manufacturer's instructions. The dry mil thickness of coatings shall be as specified in the Coating Schedule.

3.07 APPLICATION BY SPRAYING

A. Application of coatings by spraying may be permitted in locations and on surfaces approved by the Engineer. The Contractor must submit for approval a written request giving the proposed locations and the coating manufacturer's instructions for spray application. Applicator and equipment must conform to the following paragraphs:

1. Spraying shall conform to the manufacturer's recommendations.

2. Equipment:

   a. The spray equipment used shall be suitable for the intended purpose, capable of properly atomizing the coating, and equipped with suitable pressure regulators and gages. The equipment shall be in good working order.

   b. Spray equipment shall be kept sufficiently clean so that dirt, dried coating, and other foreign substances are not deposited with the coating.

   c. All solvents used in cleaning the equipment shall be completely removed before use.

   d. The equipment manufacturer's instructions for proper use shall be strictly followed.

3. Air Spray:

   a. Air caps, nozzles, and needles shall be those recommended by the manufacturers of the coating system and spray equipment being used.

   b. Moisture and oil separators or traps shall be used in the compressed air system to provide a dry and clean air supply. The traps or separators must be of adequate size and must be drained periodically during the coating application.

4. Airless Spray:

   a. Fluid tips shall be of the proper orifice size and fan angle, and the fluid control gun of proper construction, as recommended by the manufacturer of the coating system and the spray equipment being used.

3.08 CURING

A. Each coat shall be in a proper state of cure or dryness prior to the placement of the succeeding coat. Coating shall be considered sufficiently dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting, wrinkling, or loss of adhesion of the undercoat. Where an overcoat will not properly adhere to an overly cured undercoat, it shall be applied within the time period recommended by the manufacturer.

B. The curing times for the coatings shall conform to the coating manufacturer's recommendations considering ambient temperature and relative humidity.

3.09 FIELD QUALITY CONTROL

A. Thickness - The Contractor shall furnish the Engineer a suitable thickness detector of a type recommended by the coating manufacturer. Dry film measurements shall be taken in accordance with SSPC-PA 2.

B. The color of the prime coat shall be beige when available. It shall be inspected before application of intermediate or finish coats.

C. Intermediate Coats shall be the approximate shade of final coat; however, each coat shall be of a slightly different tint. Each coat shall be inspected and approved before the next coat may be applied; otherwise, credit will not be given and the Work shall be recoated.

3.10 PATCHING AND REPAIRS

A. All defective coatings shall be removed or repaired as the Engineer may direct. Surfaces with defective shop primer shall be repaired per the manufacturer's recommendations of the system in the Coating Schedule.

B. Before final approval of the Work all damaged coating surfaces (field or factory applied) shall be cleaned and repainted or touched up as directed.

3.11 CLEANING

A. Remove coating and splatter inadvertently placed on items not scheduled to be coated. Remove splatter by washing or scraping, taking care not to scratch or otherwise damage finished surfaces.

B. Remove and dispose spent abrasives, discarded coating materials, rubbish containers, rags, and other debris at the end of each work day.

3.12 MARRED EXISTING FINISHES

A. Existing buildings, pipelines, plumbing, etc., marred during construction by the Contractor shall be repainted to match the existing coating. Repainting shall be carried far enough to match the newly painted area with the existing coating.

B. Surface preparation, primer, and finish coats shall be in accordance with the Coating Schedule.

PART 4 SPECIAL PROVISIONS

4.01 COLORS

A. The colors used shall be selected by the Owner and the Engineer, from the manufacturer's standard colors.

B. All pipelines and associated equipment shall be color coded and banded as follows. Banding shall consist of 3-inch wide painted bands at 30-inch center to center.

Pipeline	Color of Pipe	Color of Legend
Natural Gas	Safety Red	White
City Water	Dynamic Blue	White
Plant Water	Aqua Tint	White
Compressed Air	Green Byte	White
Tank Drains	Black with 3-inch ultra-white band	White
Boiler Feed Water	White with 3-inch blue bands	Black
Hot Water Heat Piping	To match walls, ceilings, etc., with 3-inch brown bands	Black

C. Electrical conduit, roof drains, sanitary drains, etc., shall be painted to match the color of adjacent wall or ceiling surface.

4.02 STENCILS AND LABELS

A. Lettering and flow direction arrows shall be stenciled on each pipeline describing the function of the pipeline near the equipment served, at both sides of walls and floors where pipe passes through, and at intervals of not more than 50-feet. Flow direction arrows shall be stenciled on each pipeline adjacent to valves and at each branch or tee. It is intended that all pipelines shall bear labels at the most visible point. If, in the opinion of the Engineer, the foregoing requirements will result in an excessive number of labels or arrows on a run of pipe, the number shall be reduced as directed.

B. Where the flow of a pipeline is in one direction only, an additional flow arrow shall be stenciled in front of each legend on the pipe.

C. For pipes smaller than 1-inch in outside diameter, a white plastic tag with black lettering shall be used. Secure to piping with self-locking nylon straps.

D. The legends and flow arrows shall be stenciled with approved stencil paint. Following the completion of other Work under this Item, all stencils used shall remain the property of the Owner.

E. Each chemical storage tank shall have stenciled on its side a legend describing the tank contents and the tank number as shown on the Drawings such as "Alum Tank No. 1".

F. Preprinted pressure sensitive vinyl labels may be used in lieu of stencils. Labels shall be additionally secured to the pipe at each end by 2-inch roll tape with preprinted

directional arrows. Tape color shall match the label. Label size shall be determined by pipe size as recommended by the manufacturer's standard literature. Labels shall be Opti-Code as manufactured by Seton Name Plate Corporation, or equal.

SECTION 10251
FIREFIGHTING EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing portable fire extinguishers, and additional equipment described in Part 4 of this Section.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. A complete list of all appurtenances, materials, and a general arrangement drawing.

c. Design information and drawings for the Engineer's review.

2. Operation and maintenance manual.

PART 2 PRODUCTS

2.01 GENERAL

A. All firefighting devices shall be in accordance with OSHA Standards found in Part 1910, Subpart L, "Fire Protection".

B. All devices shall be listed by Underwriter's Laboratories and approved by Factory Mutual.

2.02 PORTABLE FIRE EXTINGUISHERS

A. Fire extinguishers shall have multi-purpose dry chemical extinguishing agent and the capability of fighting Class A, B, and C fires.

B. All fire extinguishers shall be mounted with wall hangers, unless a cabinet is called for in Part 4 of this Section, at the location shown on the Drawings.

C. Wall cabinets to house fire extinguishers, when required by Part 4 of this Section, shall be of adequate size to hold the fire extinguisher with the door closed. The cabinet shall

be recessed-mounted into the wall. The door shall be full glass type with double strength glass. The cabinet frame shall be steel with a baked enamel finish.

D. The fire extinguisher shall have a heavy-duty steel cylinder as manufactured by J. L. Industries, Larsen's, or equal. The fire extinguisher shall conform to or exceed an Underwriter's Laboratory classification as indicated in Part 4.

E. Extinguishers with plastic valves are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be made as shown on the Drawings and recommended by the manufacturer.

PART 4 SPECIAL PROVISIONS

4.01 FIRE EXTINGUISHER SCHEDULE

A. Fire extinguishers of the given types shall be mounted as noted in the following schedule. Mounting locations not shown on the Drawings shall be determined by the Engineer.

Building	Room	Extinguisher UL Rating	No. Req'd.	Mounting
Blower	Main	4A:60B:C	2	Column/Wall
Blower	Electrical Room	4A:60B;C	1	Wall
Blower	Mechanical Room	4A:60B;C	1	Wall

END OF SECTION

SECTION 10702
SIGNS AND TAGS

PART 1 GENERAL

1.01 SCOPE

A. Under this Section the Contractor shall furnish all labor, materials, equipment, and incidentals required to provide and install identification devices as shown and specified.

B. The extent of identification devices is shown on the Drawings and described herein.

C. The types of identification devices include the following:

1. Door Signs.
2. Floor Loading Signs.
3. Safety Signs.
4. Fire Extinguisher Location Signs.
5. Hazardous Material Signs.
6. Equipment Identification Nameplates.
7. Valve Tags.
8. Exit Signs.

D. The type and number of each sign required are scheduled in Part 4 unless otherwise noted.

E. Additional product requirements are specified in Section 01350.

1.02 QUALITY ASSURANCE

A. Contractor is responsible for all field measurements to ensure the proper fitting of the Work and use of the correct anchoring device.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    b. Materials of construction.
    c. Manufacturer’s catalog data.

d. Anchorage and accessory items.

e. Samples - When requested by the Engineer:

1) Full size sample of proposed product.

PART 2 PRODUCTS

2.01 DOOR SIGNS

A. Material - Laminated thermoset plastic, minimum 1/16-inch thick and 2-inch by 12-inch in size, engraved condensed 1-inch high block lettering on contrasting background and beveled front edges. Signs shall be provided with a pressure sensitive adhesive backing. Colors shall be selected by the Owner from the manufacturer's standard colors.

2.02 FLOOR LOADING SIGNS, SAFETY SIGNS, AND FIRE EXTINGUISHER LOCATION SIGNS

A. Material - As a minimum, 20-gauge steel with a baked enamel finish, 10-inch by 14-inch in size, colors and contrasting colors and letter sizes per OSHA regulations.

B. Appropriate mounting holes or anchoring device as required, single faced sign and appropriate for indoor or outdoor use.

C. Signs to conform to OSHA Safety and Health Standards - General Industry (29 CFR 1910), Subpart J - General Environmental Controls, Section 1910.145 Specifications for accident prevention signs and tags.

D. Danger Signs - White background on bottom half with red oval on black background top half; black letters on bottom half and top half to have the word "DANGER" in white letters all in the red oval; letter sizes as appropriate.

E. Caution Signs - Yellow background with black panel on top one-third with yellow letters of word "CAUTION" on panel; black letters for words and of appropriate size.

F. Informational Signs - White background with blue panel on top one-third with white letters of word "NOTICE" on panel; blue letters for words and of appropriate size.

G. Fire Extinguisher Sign - Red background with white letters of appropriate size.

2.03 HAZARDOUS MATERIAL SIGNS

A. Material - As a minimum, 20-gauge steel with a baked enamel finish, 10-3/4-inch by 10-3/4-inch in size, colors and contrasting colors and letters per DOT Specifications of the DOT Hazardous Material Regulations 40 CFR Part 172.500 as amended.

2.04 EQUIPMENT NAMEPLATES

A. Material – Brass or 304 Stainless Steel, 19 gauge thick, 2-inch diameter in size, engraved condensed black lettering on contrasting background. Provide hole(s) in tag for attachment.

B. All equipment, not included in Section 16030 and 09900 to be stenciled, shall have an identification nameplate attached. Notation shall be as shown on the Drawings, described in the appropriate sections of the Specifications, or as directed by the Engineer.

2.05 VALVE AND ACCESSORY TAGS

2.06 MATERIAL – BRASS OR 304 STAINLESS STEEL, 19 GAUGE THICK, 2-INCH DIAMETER IN SIZE, ENGRAVED CONDENSED BLACK LETTERING ON CONTRASTING BACKGROUND. PROVIDE HOLE(S) IN TAG FOR ATTACHMENT. MANUFACTURER

A. Seton Name Plate Corp. - New Haven, CT; Industrial Safety & Security Co. - Lima, OH; or equal.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine the substrates and conditions under which the devices are to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF SIGNS

A. Install identification devices and components at the locations shown or as directed by the Engineer, securely mounted with concealed theft-resistant fasteners, unless otherwise indicated.

B. Attach signs to substrates using appropriate methods so that signs are secure and free from movement, not easily removed or damaged. Such methods shall include:

1. Exterior, wet/damp/corrosive areas shall use stainless steel fasteners in substrate.

2. On handrail provide stainless steel strapping material which is wrapped around the handrail top and bottom rail and bolted to the sign. There shall be a minimum of two anchors at top and tow at the bottom.

3. Pole mount shall have a stainless steel backer plate same a 1/2 inch lager than the sign attached to the pole and the sign attached to the backer plate.

C. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Engineer.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 11050
COMMON EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Section includes the general requirements for all equipment installed under this Contract.

B. Equipment items shall meet the requirements specified herein, plus the specific requirements noted in the technical sections.

C. The specific requirements included under a particular section shall take precedence.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Specific equipment submittals are specified in the related sections.

b. Equipment shop drawings shall include outline and dimension drawings of the actual equipment being furnished.

c. With the shop drawings, the complete motor nameplate data shall be furnished as well as all information requested below which may not be on the motor nameplate:

1) Manufacturer.

2) Rated Horsepower.

3) Operating Speed Range*.

4) Operating Voltage(s).

5) Current Draws at Operating Voltage(s)*.

6) Operating Frequency (Hz).

7) Service Factor.

8) Type Enclosure.

9) Frame Size.

10) NEMA Design Designation.

11) Locked Rotor Code Letter.

12) Duty Rating.

13) Minimum Full Load Efficiency.

14) Nominal Efficiency*.

15) Power Factor*.

16) Maximum Size Capacitor Permitted to be Connected to Motor.

17) Insulation Class.

18) Location of motor terminal housing (F1 or F2).

19) Motor no load sound pressure level of dB(A) weighted at 3 feet from motor.

20) Motor Full Load Sound Pressure Level of dB(A) - weighted at 3 feet from motor.

21) Bearing Ratings.

22) Full Load Torque.

23) Break Down Torque.

24) Locked Rotor Torque.

* Provide data at following loads: Service factor (if greater than 1.0) times full load (i.e., 1.15 x full load), 100%, 75%, 50%, 25%, and no load.

d. Minimum full load efficiency shall be tested in accordance with IEEE Standards 112 Test Method B as described in Section 6.4 of IEEE Standard 112. Polyphase motors larger than 125 horsepower shall be listed in accordance with IEEE Standard 112 with stray-load loss determined by direct or indirect measurements.

2. Information for the Record:

a. Operation and maintenance manual.

1.03 QUALITY ASSURANCE

A. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the drawings.

1.04 ELECTRICAL AND CONTROL COORDINATION

A. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, and/or starter for that motor or equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be included under the Contract and no additional compensation will be allowed.

B. All electrical, instrumentation, and control equipment and panels furnished under this Contract shall conform to appropriate Sections of Division 16 of these Specifications. Equipment and panels shall be NEMA 4X, unless otherwise shown on the Drawings or Specifications.

C. Certain equipment items shall be connected to the plant control system. Those connections and any remote control connections shall be wired to clearly labeled terminal strips within the equipment control panel.

D. Analog signals for input to a programmable controller system or other device shall be 4-20 mADC and where required, current to current transducers or other device shall be furnished to produce an isolated signal to the programmable controller analog input module.

E. Digital input signal sources shall provide an isolated contact rated at 5-amp minimum, 115 VAC for AC programmable controller inputs or devices and 1 amp minimum 28 VDC for DC rated inputs or devices.

1.05 PRODUCT HANDLING

A. Unless otherwise specified in the individual sections, the Contractor shall deliver, handle, store, and maintain materials and equipment in accordance with the requirements of the manufacturer.

B. Materials, equipment, and articles to be incorporated into the Work shall be stored so as to facilitate inspection and inventory and in such manner as to ensure the preservation of their quality and fitness for the Work. Stocked materials shall be subject to test and shall meet the requirements of the Specifications at the time of substantial completion of the Work.

C. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

D. Switchgear, motor control centers, panelboards, instrument control panels, fixtures, and like equipment shall be received and stored in a dry, clean, dust-free, heated area. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner. If equipment is stored in an area conducive to the formation of condensation, heaters shall be provided to prevent

condensation. Once the equipment is installed in its final position, suitable protection shall be provided to prevent damage by falling material, dust, paint, dirt, and moisture.

PART 2 PRODUCTS

2.01 GENERAL

A. AC motor(s) shall conform to the latest applicable NEMA, IEEE, and ANSI standards.

B. Motor installation shall not exceed 88 dB(A) weighted maximum level at 3 feet from the motor throughout the entire speed range and load range.

C. Motor bearings shall be antifriction type, grease lubricated with a minimum L-10 rating of 17,500 hours for belted duty and 100,000 hours for direct coupled duty.

1. Thrust bearings in vertical motors shall be adequate for the loading encountered.

2. Belt-driven power systems with jackshafts, and couplings, to isolate the belt loadings from the motor bearings shall be regarded as direct coupled duty.

D. Motor conduit boxes shall be sized with capacity to meet the requirements of the National Electrical Code. Motors shall be furnished in an “F1” terminal housing assembly (facing connection box, motor shaft extension is to the right) unless otherwise shown on Drawings or specified.

E. Motor frames shall be cast iron construction with corrosion resistant hardware.

F. Each motor shall be continuous duty rated NEMA Design B with normal starting torque, unless otherwise shown or specified.

G. Output torque and speed characteristics of each motor shall be suitable to operate the connected load over the full range of operating speeds and load conditions without exceeding the nameplate current rating or temperature rise on a continuous duty basis.

H. Insulation shall be Class F or Class H.

I. Each polyphase squirrel-cage induction motor shall meet or exceed minimum and nominal efficiencies listed in NEMA MG-1, Table 12-10.

J. If information in this section conflicts with specific equipment or division 16 specifications then the specific equipment or division 16 specification shall take precedence.

2.02 AC MOTORS UNDER 1 HP

A. Unless otherwise shown or specified, each fractional motor under 1/2 hp shall be designed for single phase, 115 and 230 volt, 60 Hz service.

B. Unless otherwise shown or specified, each fractional motor 1/2 through 3/4 hp shall be designed for 3 phase, 208, 230, and 460 volt, 60 Hz service.

2.03 INTEGRAL AC MOTORS

A. AC motor(s) 1 hp and larger shall have a 1.15 service factor at a 40 degrees C ambient temperature. Motor shall be capable of operating at the 1.15 service factor rating on a continuous basis per NEMA MG1-12.42 Item 1b.

2.04 SPECIAL APPLICATION MOTOR(S)

A. Special application motor(s) are defined as those used on such devices as appliances, tools, unit heaters, door operators, refrigeration units and sump pumps.

B. Manufacturer's standard motor may be approved by the Engineer where a redesign of the unit would be required to furnish energy efficient motors.

2.05 DEFINITE PURPOSE MOTORS

A. Equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.

1. Definite purpose motors are hermetic refrigeration compressors, jet pumps, shaft mounted fans and blowers, submersible deep well pumps, submersible mixers, elevator, crane, close coupled pumps, and torque motors.

2. If available, an energy efficient design motor shall be furnished on this application.

2.06 MOTORS ON VARIABLE FREQUENCY DRIVES

A. Motors for use with a Variable Frequency Drive (VFD) shall be TENV, TEFC, or submersible, water cooled.

1. Design to meet or exceed the efficiencies listed in NEMA MG-1, Table 12-10.

2. Motor shall be "Inverter Duty Rated", and so stamped on the nameplate.

3. Motor shall have an insulation system that meets or exceeds the requirements of NEMA MG-1, Part 31.40.4.2, and is rated at 1600 volts peak to ensure that the motor is rated for operation with non-sinusoidal waveforms at 1.0 service factor.

4. Bearings in motors greater than NEMA Frame size of 300 and controlled by variable frequency drives must be guaranteed against premature bearing failure caused by discharge current. All such motors shall be provided with a shaft grounding device.

B. AC motor used with a VFD shall have internal thermal protectors guaranteed by the motor manufacturer to protect the motors against overheating from stalled or slow turning due to lack of adequate cooling at low motor speeds.

1. Thermal protection devices shall be imbedded within the motor windings with normally closed contacts to be used in series with the coil of the motor's magnetic bypass starter and the stop circuit on the VFD.
2. Thermal protection devices shall all be provided and housed within the motor housing, unless otherwise specified.

C. Explosion proof motors shall use thermal protectors required by UL as covered by 2.08, and meet the requirements of 2.06 preceding, and shall be rated and labeled for "Inverter Duty".

D. Tachometer generators when required by the Specifications or the P&ID Drawings shall be DC generators of the enclosure required for the particular motor location.

2.07 RESERVED

2.08 EXPLOSION PROOF MOTORS

A. AC motors for use in a Class I, Division 1, Group D location shall meet the requirements of paragraph 2.01 above.

B. Explosion proof motors 3 hp and larger shall have a 1.15 service factor. Such motors shall be capable of operating at the 1.15 service factor rating on a continuous basis per NEMA MG1-12.42 Item 1b.

C. Each motor shall be furnished with internal thermal protectors with normally closed contacts that will open should the safe operating motor temperature be exceeded per UL requirements. These contacts shall be placed in series with each other and with the coil of the magnetic motor starter, and/or the VFD enable circuit if used with a VFD, on all applications.

2.09 MOTOR SPACE HEATERS

A. Space heaters as specified or shown on the Drawings shall be factory installed by the motor manufacturer.

2.10 RESERVED

2.11 COUPLED DRIVES

A. Coupled drives shall have the service factor recommended by the coupling manufacturer.

B. Coupled drives shall be submitted with engineering data supporting the horsepower rating of each coupling.

2.12 SAFETY GUARDS

A. Installed equipment shall be equipped with all guards, shields, and devices to meet OSHA requirements.

B. Chain and belt guards shall be totally enclosed steel construction, 14-gauge minimum for guards up to 60-inch center distance and 12-gauge minimum for larger guards.

C. Guards shall include expanded metal inspection panels. Removable access panels shall be provided to perform routine maintenance.

2.13 MANUFACTURER'S NAMEPLATE

A. Equipment shall be identified by permanently attached nameplate of corrosion-resistant metal. Plates shall bear the following information:

1. Manufacturer's name.
2. Serial and model numbers.
3. Rated capacity.
4. Temperature, pressure, or other limitations.

2.14 ANCHOR BOLTS

A. Equipment anchor bolts shall be as specified in Section 05500.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's instructions and Contract Documents. Required anchors, grout, and leveling shims shall be provided by the Contractor.

B. Alignment procedures and acceptable runout tolerances on couplings shall be submitted.

3.02 ROTATING EQUIPMENT ALIGNMENT

A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.

B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the "16-point" method. Other proposed methods must be submitted for approval to the Engineer.

C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and

the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

3.03 INITIAL LUBRICATION

A. Initial lubrication required for start-up, field test operation, and normal operation prior to substantial completion shall be furnished and applied in accordance with the manufacturer's recommendations.

B. Where lubricating points are not easily accessible, provide extensions as required for easy access with normal grease gun.

3.04 PACKING

A. Each shaft containing a packing gland shall be checked for condition by backing the packing gland off and examining for proper grade, amount, and type of packing as recommended by the manufacturer.

3.05 MAINTENANCE

A. The Contractor shall perform and log all preventive maintenance tasks as recommended by the manufacturer while the equipment is in storage and after installation until the equipment has been accepted by the Owner.

3.06 TROUBLESHOOTING

A. Should a problem occur before acceptance, the Contractor shall determine the cause and recommend corrective actions to the Engineer. The Contractor shall correct equipment and installation deficiencies.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 11165
DOCK BUMPERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes dock bumpers.

B. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Contractor shall indicate variances from requirements of Contract Documents.

b. Product literature.

PART 2 PRODUCTS

2.01 DOCK BUMPERS

A. Bumper shall extend 4-1/2 inches from the edge of dock.

B. Bumpers shall be rubberized-fabric truck tires cut to uniform size pads, 10-inch by 24-inch and punched to receive support rods. Pads shall be stacked on 3/4-inch support rods and compressed between two 3-inch by 2-1/2-inch by 1/4-inch steel angles.

C. Bumpers shall be Style B4512-24 by Durable Corp., Style B1010-24, by American Floor Products Co., or equal.

D. Anchor bolts shall be furnished in accordance with Section 05500.

PART 3 EXECUTION

3.01 INSTALLATION

A. Bumpers shall be installed as indicated on the Drawings and in accordance with manufacturer's recommendations.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 13650
PRE-ENGINEERED METAL BUILDING ERECTION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all equipment and labor required to erect the following:

1. Structural building framing.
2. Insulated metal roof panels.
3. Insulated metal wall panels.
4. Gutters and Downspouts
5. Framed openings for personnel doors, services doors, windows, louvers, and vents.
6. Snow guards

1.02 SUBMITTALS

A. Submittals shall be in accordance with all requirements of Section 01300 and Section 01410 and shall include:

1. Information for the Record:
   a. Erector Certificate: Signed by manufacturer, certifying that erector complies with the manufacturer's experience and workmanship requirements.
   b. Warranties as specified herein.
   c. Record drawings recording any modification to the building after procurement.

1.03 QUALITY ASSURANCE

A. The Erector shall be a firm experienced in erecting metal building systems similar to those indicated for this Project and with a record of successful in-service performance.

B. The Erector shall be a pre-qualified by the building manufacturer to erect the components of the building to include, but not limited to, the building frame, roof panels, wall panels, personnel doors, services doors, windows, louvers, gutters and downspouts.

C. The erection shall be in accordance with the following standards:

1. AISC 360 – Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design.

2. AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members.

1.04 PROJECT HANDLING

A. Handling - Unload, store, and erect roof and wall panels to prevent bending, warping, twisting, and surface damage.

B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store roof and wall panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage. Follow manufacturer's storage recommendations.

1.05 WARRANTIES

A. The Erector shall honor his duties under the warranties issued by the building manufacturer.

PART 2 EXECUTION

3.01 COORDINATION

A. Coordinate location of anchor-bolts installed in the building's foundation walls and footings. Anchor bolts requirements are provided by specification section 05120.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in individual specification sections.

C. Coordinate the installation of heavy-duty aluminum doors and frames with specification 08125.

D. Coordinate the installation of aluminum windows, if any, with the individual specification section..

E. Coordinate the installation of roll-up doors with specification 08315.

F. Coordinate the installation of overhead and vertical lift doors with 08310.

G. Coordinate all mechanical wall openings with mechanical construction drawings and mechanical contractor.

H. Anchor bolts shall be delivered in sufficient time to permit proper placement in concrete foundation.

I. System for resisting building lateral forces shall be constructed prior to erection of building.

1. Where lateral building forces are resisted by concrete foundations, building erection shall not begin until foundation concrete has obtained specified design strength.

2. Where lateral building forces are resisted by concrete floor slab, building erection shall not begin until floor slab concrete has obtained specified design strength.

J. Foundation dimensions shown on Drawings are as required by a preliminary building system. Contractor shall coordinate foundation dimensions with approved building system and column layout.

K. Foundation has been designed for a preliminary building system. Engineer will require modification to foundations when column reactions of approved building system vary from preliminary values.

L. Foundation modifications shall be made at no additional cost to Owner.

3.02 PREPARATION

A. Clean substrates of substances, including oil, grease, rolling compounds, incompatible primers, and loose mill scale that impair bond of erection materials.

B. Surface Preparation - Clean and prepare surfaces to be painted according to manufacturer's written instructions for each substrate condition and as specified.

3.03 ERECTION AND INSTALLATION

A. Erect metal building system according to manufacturer's written instructions and erection drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Align and adjust framing members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Make adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Primary Framing and End Walls - Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures.

1. Make field connections using high-strength bolts.

F. Secondary Framing - Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts. Hold rigidly to a straight line by sag rods.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.

2. Locate and space wall girts to suit door and window arrangements and heights.

3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

G. Bracing - Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.

H. Framing for Openings - Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.04 ROOF PANEL INSTALLATION

A. General

1. Follow panel manufacturer's installation instructions.

2. Field cutting by torch is not permitted.

3. Provide weather seal under ridge cap.

4. Flash and seal roof panels with weather tight closures at eaves, rakes, and at perimeter of all openings. Fasten with mechanical fasteners.

5. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

A. Provide waterproof jacks for pipes and conduits panel penetrations.

B. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by metal panel manufacturer.

3.05 WALL PANEL INSTALLATION

A. General

1. Follow panel manufacturer's installation instructions.

2. Field cutting by torch is not permitted.

3. Fasten flashing and trim around openings and similar elements with mechanical screws.

4. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

5. Provide weather-resistant escutcheons for pipe and conduit penetrating exterior walls.

6. Flash and seal wall panels with weather tight closures under eaves and rakes, along lower panel edges, and at perimeter of all openings.

7. Apply elastomeric sealant continuously between metal base channel or sill angle and concrete, and elsewhere as necessary for waterproofing. Handle and apply sealant and backup according to sealant manufacturer's written instructions.

3.06 ACCESSORY INSTALLATION

A. General - Install gutters, downspouts, ventilators, louvers, and other accessories according to manufacturer's written instructions, with mechanical anchorage to building and weathertight mounting. Coordinate installation with flashings and other components.

B. Flashing and Trim - Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Engineerural Sheet Metal Manual." Provide for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions - Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters - Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet OC using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts - Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches OC in between.

1. Provide elbow at base of downspout to direct water away from building unless noted to be tie to underground drainage system.

2. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing - Form flashing around pipe penetration and roof panels. Fasten and seal to roof panel as recommended by manufacturer.

3.07 ERECTION TOLERANCES

A. Structural-Steel Erection Tolerances - Comply with erection tolerance limits of AISC S303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Roof Panel Installation Tolerances - Shim and align units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Wall Panel Installation Tolerances - Shim and align units within installed tolerance of 1/4 inch in 20 feet on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.08 PROTECTION

A. Touchup Painting - Immediately after erection, clean, prepare, and prime or reprime welds, bolted connections, and abraded surfaces of prime-painted primary and secondary framing, accessories, and bearing plates.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.

2. Apply compatible primer of same type as shop primer used on adjacent surfaces.

B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

C. Roof and Wall Panels - Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

D. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 15010
GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing mechanical accessories and requirements necessary for the completion of the Work whether or not specifically shown or specified.

B. Items include, but are not limited to:

1. Piping Hangers and Supports.
2. Insulation Fire Retardant Requirement.
3. Accessibility and Access Panels.
4. Power Actuated Anchors.
5. Rotating Equipment Alignment.

C. Additional requirements are specified in Sections 01350 and 11050.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. Descriptive information on all mechanical items.
    b. Drawings locating anchors, inserts, and supports for piping, including vendor data for each component.
2. Information for the Record:
    a. Alignment procedures and acceptable runout tolerances for each piece of connected equipment.
    b. Shaft and bore sizes and tolerances for couplings and instructions for coupling installation.
    c. A report of coupling alignment readings for each coupling and driven machine combination, and sizes of all anchor bolt or equipment base shims.

PART 2 PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

A. The manufacturer's names and catalog numbers shown in the following paragraphs have been used as a guide to type, style, and materials of construction only. Anvill, Unistrut, or equal.

B. Contractor shall furnish and install all pipe supports, hangers, harnessing, expansion joints, expansion loops, and inserts required to support the piping and valves. Supports shall be designed and spaced to secure pipe in place without sag or undue stress on any pipe, fitting, equipment, or valve. Piping that is close to the floor may be supported on concrete piers. Piping near walls may be supported by wall brackets. Piping at equipment and valves, etc., shall be supported so that the equipment and valves can be removed without additional pipe supports. Piping shall not introduce any strains or distortion to connected equipment. Overhead lines shall be installed directly on supports, or suspended by hangers or hanger rods. Where piping is supported from the ceiling, inserts shall be poured in the concrete slab flush with the bottom of the slab. Adequate lateral support shall be provided to prevent noticeable lateral movement of the piping either during operation, or from a lateral load of 300 pounds applied at any point. All hanger design, anchoring, support, etc. shall be the responsibility of the Contractor. Design loads shall not exceed the manufacturer's recommended loads.

C. Types of Supports:

1. All horizontal piping 4-inch and larger with inverts 2-feet or less from a finished floor shall be supported by concrete saddle supports, unless otherwise specified in Part 4 of this Section.

2. Beam clamps shall be used where piping is supported from steel structure of building. Clamps shall be selected on basis of load to be supported. Beam clamps shall be malleable iron with bolt, nut, and pocket threaded for rod connection as required to fit beams. C-clamp type shall only be hung from truss panel points unless otherwise approved by the Engineer.

3. In precast slab areas supports shall be hung from tabs. Tabs shall not be overloaded. Contractor shall not drill into precast slabs unless approved by the Engineer.

4. Cast-in inserts shall be used for suspending hangers from concrete. For heavier loads, insert shall be ceiling type, individual inserts; Anvill CB - Universal concrete inserts, Figure 282, or equal. For lighter loads, inserts shall be Unistrut P-3200 series, or equal. The preformed channel members shall be 1-5/8-inch by 1-3/8-inch with a 12-gauge (.105 inch) material thickness. Anchors shall be at 4-inch on center maximum, and extend into concrete a minimum of 2-3/4-inch. End caps and/or end cap anchors shall be provided to prevent concrete seepage into channels. All channels shall have a pre-galvanized finish, and all accessories shall be electro-galvanized. Insert shall not be overloaded.

5. Vertical piping shall be supported at base by hanger placed in horizontal line near riser, or by base fitting set on pedestal or foundation. Risers shall be laterally supported at intermediate points with riser clamps with two-point bearing as required to make rigid. Riser clamps shall be wrought steel, with extension lugs, bolt, and nuts; Anvill Figure 261, or equal. Offset pipe clamps, Anvill Figure 103, or equal, may also be used. Use only in unfinished areas where approved by the Engineer. Anvill Figure CT-121, or equal, shall be used for copper pipe.

6. Unless otherwise noted, hangers shall be as follows:

    a. Uninsulated piping 2-inch and smaller, Anvill Figure 97, or equal malleable iron adjustable nut and steel band.

    b. Uninsulated piping 2-inch and larger, Anvill Figure 260, or equal, galvanized steel adjustable clevis type.

    c. Uninsulated copper tubing, Anvill Figure CT-69, or equal, carbon steel ring and knurled swivel iron adjusting nut completely copper plated.

    d. Insulated piping, Anvill Figure 260, Elcen, or equal, clevis hangers. An insulation protection shield, Anvill Figure 167, or equal, shall be installed over the insulation in 180-degree segment, minimum 12-inch long. The shield shall be galvanized steel and shall vary in thickness from 18-gauge to 12-gauge, according to pipe size, as required to prevent crushing of the insulation. Anchors and guides shall be installed as required. Where roller supports are required due to expansion or contraction, Anvill Figure 171 roller hangers, Anvill Figure 175 roller chairs, Anvill Figure 271 pipe roll stands, or equal shall be used.

7. Trapeze Hangers and Brackets:

    a. Where several pipes occur at the same elevation, trapeze type hangers or other equivalent types may be used.

    b. For heavier loads, trapeze hangers shall be structural steel channels suspended from threaded rods. Channels shall be galvanized and sized for specific loads. For 12-inch piping and larger, short pieces of angle (1/4-inch minimum thickness) shall be welded to the channel such that pipe circumference will be supported at 3 points approximately 30 degrees apart. Fabricated saddles supporting a 60-degree minimum segment of the pipe may also be used. Standard black carbon steel “U”-bolts, Anvill Figure 137, or equal, shall be used to secure piping up to 36-inch diameter to structural channels. For lighter loads, trapeze hangers shall be preformed channels. Channel members shall be 1-5/8-inch by 1-5/8-inch with a 12-gauge (.105) material thickness. They shall be Unistrut Series P-1000, or equal, with a pre-galvanized finish. All fittings, spring nuts, nuts, and bolts shall be electrogalvanized. Steel threaded rod hangers shall be galvanized.

c. Brackets shall be Anvill Figure 195, or equal, as required for weight of pipe. Brackets for use with preformed Unistrut or equal channels shall be fabricated from 12-gauge material, compatible with the 1-5/8-inch square channel members. Unistrut or equal brackets shall be galvanized. All fabricated steel brackets used to support piping in or above tanks, channels, and flumes shall be hot dip galvanized after fabrication and all fasteners shall be galvanized.

d. The following general rules shall be followed for attachments:

1) Uninsulated steel piping, use Unistrut Series P-1109 through P-1126, or equal clamps.

2) For copper tubing, use Unistrut Series P-2024CC through P-2070CC clamps, or equal.

3) Insulated piping 2-inch and smaller, use Anvill Figure 167, 18-gauge galvanized steel shield over the insulation, in 180-degree segments minimum 12-inch long with Anvill Figure 271, or equal, clamps.

4) Insulated piping 2-1/2-inch and larger, use a protection saddle, Anvill Figure 160 through 166, or equal, with Anvill Figure 271, or equal, roller supports.

8. In tunnels, pipe galleries, and where piping is racked on multiple hangers, supported with the use of prefabricated structural support channels, the piping attachments shall be as specified for Trapeze Hangers.

D. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchors shall be suitable for the location of installation and shall be designed to withstand not less than five times the anchor load. Vertical pipes shall be anchored by means of clamps welded around pipes and secured to wall or floor construction. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellow type expansion joints may be located adjacent to the joint.

1. Pipe guides shall be provided adjacent to bellows type expansion joints. Guides shall be placed on both sides of expansion joints except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joining and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Guide and spider shall be of sufficient size to clear pipe insulation and long enough to prevent overtravel of spider and cylinder. Pipe guides shall be Anvill Figure 255, or equal, and shall be installed as recommended by the manufacturer.

2. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be:

Type of Pipe	Pipe Support Max. Spacing, ft	Max Run Without Expansion Joint, Loop, or Bend, Ft	Expansion Joint Max. Spacing, ft	Type of Expansion Joints
Cast Iron/Ductile Iron	10 (Note 4)	80	80	Mechanical Couplings
Steel for hot water heating				
1-1/4-inch and smaller	7	30	100	Note 1
1-1/2- to 4-inch	10	30	100	Note 1
Over 4-inch	15	30	100	Note 1
Steel for other services				
1-1/4-inch and smaller	7	30	100	Note 1
1-1/2- to 4-inch	10	30	100	Note 1
Over 4-inch	15	80	80	Mechanical Couplings
Copper for hot water				
1-inch and smaller	5	20	100	Note 1
Over 1-inch	7	20	100	Note 1
Copper for other services				
1-inch and smaller	5	--	--	None required
Over 1-inch	7	50	100	Note 1
PVC				
1/8- to 1-inch	Continuous Support (Note 2)	20	60	Note 1
1-1/4- to 2-inch	4	20	60	Note 1
Over 2-inch	6	20	60	Note 1
Fiberglass reinforced plastic				
3-inch and smaller	6	60	100	Note 1
Over 3-inch	8	40	100	Note 1
Acid Waste				
Tempered glass	8 (Note 3)	--	--	None required
High silicon iron	15 (Note 4)	--	--	None required
Cast iron soil	10 (Note 4)	--	--	None required

Notes:

1. Expansion joint fittings as specified in the applicable miscellaneous piping section.
2. Hanger and bracket spacing may be increased where PVC pipe is provided continuous support.
3. At least two properly padded supports for each pipe section.
4. At least one support for each pipe section.

3. Pipe expansion joints shall be installed within 5-feet of all structural isolation or expansion joints. Expansion joints shall be as specified in the appropriate Section of this Contract, and submitted for approval.

E. Expansion Loops - Where fabricated expansion loops are shown on the drawings or deemed by the Contractor to control the system, expansion loops shall be designed by the Contractor and submitted for approval.

F. Use correct size hanger to allow for increased diameters of line caused by pipe covering. The Contractor will not be allowed to cut or reduce specified covering to allow application of hangers, unless otherwise specified.

G. Galvanic Protection - A dielectric material shall be placed between pipe and supports when dissimilar metals are used. A flexible elastomer material, Unistrut unicushion P-2600, or equal, may be used. A thermoplastic elastomer cushion, the Unistrut Cush-A-Clamp or equal, may also be used. In general, if galvanized supports are used, all accessories shall be galvanized. If carbon steel supports are used, all accessories shall be carbon steel.

H. Support mechanical coupling pipe at each joint.

I. Other means of pipe supports not be used unless approved by the Engineer.

J. Pipe supports shown on the Drawings shall be provided and do not relieve the Contractor of any of the requirements in this Section.

2.02 FIRE RETARDANT INSULATIONS

A. All insulation material (insulation, jackets, adhesives, cements, mastics, sealers, coatings, and finishes) shall have composite Fire and Smoke Hazard ratings as tested under ASTM E84, NFPA 255, and UL 723, not exceeding as follows: (unless noted otherwise in UBC)

Flame Spread 25 Smoke Developed 50

B. All surfaces shall be clean, dry, and free of oil and grease before insulation, adhesives, or mastics are applied.

C. All joints shall be tight with insulation lengths and segments tightly butted against each other. Where lengths or segments are cut, cuts must be smooth and square. All insulation shall be continuous through wall and ceiling openings. Insulation shall be continuous through pipe hangers. At pipe hangers, use rigid pipe covering finished the same as the adjacent pipe covering.

D. Where vapor barrier jackets are used on cold surfaces, insulation must be applied with vapor seal integrity maintained throughout the entire system.

E. All pipe insulation shall be pre-molded, and be split ready for application.

PART 3 EXECUTION

3.01 ACCESSIBILITY AND ACCESS PANELS

A. Install work to be readily accessible for operation, maintenance, and repair. Minor deviations from Drawings may be made; however, major changes shall not be made without approval of the Engineer.

B. Where valves, traps, or other specialties are concealed in the construction or behind a wall or ceiling surface, the Contractor shall furnish and install an access panel of adequate size to permit adjustment or service of concealed device. Panels shall be of a design suitable for installation in the material forming the finished surface in which each is mounted. Provide access doors in ductwork and equipment housing and wherever required for access to internals. Minimum door size shall be 24-inch by 24-inch unless duct is less than 24-inch wide, then door size to be same as duct width.

C. Wherever practical, the Contractor shall group valves, traps, dampers, etc., in such a way as to be accessible from a single panel and eliminate as many access panels as possible.

D. Ceiling access shall be required in gypsum wallboard, plaster, and other ceilings, etc., and in all locations as required to gain access or service mechanical components. Frames shall be constructed of 16-gauge steel. Panels shall be of the material used in the ceiling construction in which they are installed.

E. Access doors in insulated walls, floors, or ceilings shall be insulated equally to their surroundings.

3.02 POWER ACTUATED ANCHORS

A. Power actuated anchoring devices shall not be used at floors, columns, beams, precast concrete, where so using causes cracking, spalling, or other deformation to these members. In no case, will such anchors be used less than 4-inch from any corner nor change in direction of concrete surface to which anchor is attached.

3.03 ROTATING EQUIPMENT ALIGNMENT

A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.

B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the “16-point” method. Other proposed methods must be submitted for approval to the Engineer.

C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and

the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

PART 4 SPECIAL PROVISIONS

4.01 SUPPORT MATERIAL SCHEDULE

A. Exterior – All exterior supports shall be 304 stainless steel.

B. In Chamber or Exposed to Wastewater – All supports shall be 304 stainless steel.

C. Biofilter Bower Building – All supports shall be 304 stainless steel.

END OF SECTION

SECTION 15075
IDENTIFICATION FOR HVAC/PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. Work Included:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 – Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop drawings for review:
    a. Product Data: Submit manufacturers catalog literature for each product required.
    b. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
    c. Samples: Submit two samples of each type of identification device.
2. Information for the record:
    a. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.04 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.05 PROJECT REQUIREMENTS

A. Use plastic nameplates where in-service surface temperature will not exceed 150 degrees F.

B. Use metal nameplates where in-service surface temperature will exceed 150 degrees F.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. W.H. Brady Co., Signmark Division.
2. Seton Name Plate Co.
3. Or equal.

B. Plastic Nameplates:

1. Material: Laminated, three-layer plastic with engraved black letters on white background; satin finish with beveled edges.
2. Minimum Size: 4 inches by 1-1/2 inches.
3. Provide each plate with two mounting holes and 3/8-inch No. 3 round head stainless steel screws. Provide adhesive for mounting nameplates where screws are not practical.

C. Metal Nameplates:

1. Material: Aluminum, 0.020 inches thick, with black enamel background with natural aluminum border and text.
2. Minimum Size: 4 inches by 1-1/2 inches.
3. Provide each plate with two mounting holes and 3/8-inch No. 3 round head stainless steel screws. Provide adhesive for mounting nameplates where screws are not practical.

2.02 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

B. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.03 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2-inch high letters.

2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.

3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4-inch high letters.

4. Ductwork and Equipment: 1-3/4-inch high letters.

B. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

2.04 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, performed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored. Continuously printed, plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 UNDERGROUND WARNING TAPE

A. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis, and other soil components.

1. Size: 0.004 inch thick; 6 inches wide.

2. Color: As selected.

3. Service Marking: Printed text in black color repeated at maximum 40 inches intervals.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09900 for stencil painting.

3.02 INSTALLATION

A. Apply stencil painting in accordance with Section 09900.

B. Install identifying devices after completion of coverings and paintings.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. For plumbing items, identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

H. For HVAC items, identify all equipment with plastic nameplates. Identify in-line pumps and other small devices with tags.

I. Identify control panels, major control components, and thermostats on the outside of panels with plastic panels. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify valves in main branch piping with tags.

K. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, or stenciled painting. Use tags on piping 3/4-inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Identify ductwork with plastic nameplates or stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 15080
PLUMBING INSULATION

PART 1 GENERAL

1.01 SCOPE

A. Work Included:

1. Plumbing piping insulation, jackets, and accessories.
2. Plumbing equipment insulation, jackets, and accessories.

B. This Section includes furnishing all materials, equipment, labor, and supervision to install insulation work including insulation, cements, mastics, adhesives, attachment pins, studs, or clips, covering, lagging, jackets, hardware, flashing, and finishes.

C. Work shall be complete, in full conformance with the material manufacturer's requirements and recommendations, applicable national standards, the National Insulation Contractors Association, National Commercial, and the Industrial Insulation Standards.

D. All insulation as applied shall meet or exceed the requirements of this Section or the applicable version of ASHRAE/IES Standard 90.1.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop drawings for review:
   a. Product Data: Submit manufacturers published literature indicating product description, thermal characteristics, list of materials and thickness for each service, and location. Include the method of fastening.
2. Information for the record:
   a. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
   b. Substantiation of vendor compliance with codes, standards, or test methods noted herein.

1.03 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum three years documented experience.

E. Applicator: Company specializing in performing Work in this section with minimum three years documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the requirements of Section 01350 concerning transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation form weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.05 ENVIRONMENTAL REQUIREMENTS

A. In accordance with the requirements of Section 01350 concerning environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials furnished under this specification shall be standard, catalogued products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free of all defects.

B. Materials include insulation materials, accessories (staples, bands, mesh, wire, clips, pins, tape, anchors, corner angles, and similar recommended accessories) and compounds (cements, adhesives, coatings, sealers, protective finishes, and similar items recommended for the applications indicated).

C. The Contractor, unless clearly otherwise stated, shall supply materials which meet the owner's requirements with respect to the design criteria, thermal conductivity, and standards.

D. The Contractor shall warrant that materials furnished and installed be free of defects for a period of one year from the time the system is completed.

E. If a defect occurs in materials, workmanship, or application within the stated time, the Contractor shall promptly repair or replace the defect. Damages caused by others shall be repaired at the expense of the damaging party.

F. Specified components of the insulation system, including facings, mastics, and adhesives should have a fire hazard rating not to exceed 25 for flame spread, and 50 smoke developed, as tested under ASTM E84.

G. All accessories and materials (i.e. coatings, adhesives, sealers, etc.) are to be shipped to the job site in marked, unopened containers as received from the manufacturer.

H. Provide and install insulation, cements, mastics, adhesives, covering, lagging, flashing, and finishes in full conformance with the material manufacturer's requirements and the recommendations, applicable national standards, the National Insulation Contractors Association, and the Industrial Insulations Standards.

2.02 PIPE INSULATION

A. Glass Fiber Insulation:

1. Manufacturers:
    a. Owens Corning Fiberglass, SSL II.
    b. Johns Manville Micro-Lok.
    c. Knauf Fiber Glass Pipe Insulation.
    d. Or equal.
2. Insulation: ASTM C547; rigid molded glass fiber, non-combustible.
    a. Thermal Conductivity (k-Value): ASTM C335, 0.24 at 75 degrees F.
    b. Operating Temperature Range: 0 to 850 degrees F.
    c. Maximum Moisture Absorption: 0.2 percent by volume.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive with longitudinal laps and butt strips.
    a. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
4. Jacket Temperature Limit: Minus 20 to 150 degrees F.

B. Flexible Cellular Foam Insulation:

1. Manufacturers:
    a. Armacel, LLC; Armaflex.
    b. Rubatex.

c. Or equal.

2. Insulation: ASTM C534 Grade 1; flexible, cellular elastomeric, Type I Molded or Type II Sheet.

a. Thermal Conductivity (k-Value): ASTM C177 or C518; maximum 0.28 at 75 degrees F.

b. Operating Temperature Range: Minus 297 to 220 degrees F.

c. Water Absorption: ASTM C209; 0.2 percent for molded or sheet by volume.

d. Moisture Vapor Transmission: ASTM E96; maximum 0.08 perm inches.

e. Connection: Water-proof vapor barrier adhesive.

f. Density: ASTM D1622 or D1667; 3.0 to 6.0 pounds per square foot.

C. Cellular Glass Insulation

1. Manufacturers:

a. Pittsburgh Corning Corporation, FOAMGLAS.

b. Or equal.

2. Insulation: ASTM C552; cellular glass thermal insulation for both above grade and direct burial underground, pure glass, totally organic.

a. Thermal Conductivity (k-Value): ASTM C177 or C518; 0.33 at 75 degrees F.

b. Operating Temperature Range: Minus 100 to 900 degrees F.

c. Maximum Moisture Absorption: ASTM C240; 0.2 percent by volume.

d. Moisture Vapor Transmission: ASTM E96; 0.00 perm inches.

e. Maximum Flame Spread: ASTM E84; 5.

f. Maximum Smoke Developed: ASTM E84; 0.

g. Density: ASTM C303; 8.0 pounds per cubic foot.

3. Jacketing:

a. Manufacturers:

1) Pittsburgh Corning Corporation, PITTWRAP CW40.

2) Or equal.

b. Jacket: 40 mil thick, self-sealing, non-metallic sheet for protecting underground cellular glass insulation. Consists of a polymer modified bituminous compound reinforced with a 4 mil high density cross laminate polyethylene top film and release paper backing.

c. Operating Temperature Range: Minus 25 to 100 degrees F on outside of insulation.

d. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.

e. Weight: 0.31 pounds per square foot.

f. Minimum Application Temperature: Without primer, 50 degrees F; with primer, 20 degrees F.

2.03 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Manufacturers:

a. Johns Manville, Zeston 300 Series.

b. Or equal.

2. Jacket: ASTM D1785, one-piece molded type PVC fitting covers and sheet material, off-white color.

3. Operating Temperature Range: 0 to 150 degrees F.

4. Maximum Vapor Transmission: ASTM E96; 0.002 perm inches.

5. Maximum Flame Spread: ASTM E84; 25.

6. Maximum Smoke Developed: ASTM E84; 50.

7. Thickness: 30 mil.

8. Connections: Brush on welding adhesive.

B. Stainless Steel Pipe Jacket:

1. Manufacturers:

a. ITW Pabco/Childers.

b. Or equal.

2. ASTM A240 and ASTM A666, Type 304 stainless steel.

3. Thickness:

Outer Insulation Diameter (Inch)	Minimum Stainless Steel Jacket Thickness (Inch)	
	Rigid Insulation	Non-Rigid Insulation
≤ 8	0.010	0.010
Over 8 thru 11	0.010	0.016
Over 11 thru 24	0.010	0.020
Over 24 thru 36	0.016	0.024
> 36	0.020	0.024

4. Finish: Smooth.
5. Metal Jacket Bands: 3/4-inch wide, 0.020-inch thick stainless steel.

2.04 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 Inches Diameter and Smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length based on pipe size and insulation thickness.

D. Piping 2 Inches Diameter and Larger: Wood insulation saddle, hard maple. Inserts length not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum or stainless steel jacket, single piece construction with self adhesive closure. Thickness to match pipe insulation.

F. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

G. Adhesives: Compatible with insulation.

2.05 RESERVED

PART 3 EXECUTION

3.01 GENERAL

A. All insulation work shall be performed by skilled mechanics regularly engaged in the insulation trade.

B. The Contractor shall be responsible for coordination and cooperation with the Owner and other trades so that the installation is performed with minimum interference and conflict.

C. The final appearance of the insulation work shall be a neat, workmanlike and attractive insulation system.

D. Progressive testing of systems to be insulated shall have been completed, inspected, and approved by Owner's representative before insulation is applied.

E. Insulation shall not be applied until all surfaces are clean, dry, free of dirt, dust, grease, frost, moisture, and other imperfections.

F. Suitable application temperature and conditions shall be provided by others.

G. Insulation shall be protected from moisture and weather during storage and installation. Applied insulation which has become wet shall be thoroughly dried before it is sealed or jacketed.

H. The Contractor shall not arc-weld brackets, clips, or other devices to ASME coded pressure vessels or piping. Insulation pins or studs shall be as specified and installed in accordance with acceptable standards.

I. Insulation, fabric, and jacketing shall be protected from mechanical damage during construction. Damage by the insulator shall be repaired without cost to the Owner.

J. Contractor is responsible for proper material storage at the Work site.

K. Work performed prior to receipt of approved documents or submittals, which later proves to be incorrect or inappropriate, shall be promptly replaced by the Contractor without cost to the purchaser.

L. Insulation shall not be installed until adequate access and clearances at control mechanisms, dampers, sleeves, columns, and walls have been provided.

M. All insulation at handholes, access doors, or other openings, and adjacent to flanges and valves shall be neatly finished where exposed to view.

N. Where insulated pipes or ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening.

O. Vapor barriers shall be continuous through sleeves, hangers, etc. If pierced, vapor barriers shall be covered and suitably resealed.

3.02 INSTALLATION

A. Pipe insulation shall include all fittings, valves, (including bonnets) piping specialties, pumps, tanks, and heat exchangers.

B. Prior to insulating, all required inspections, examinations, and tests (such as hydrostatic tests, air pressure tests, and heat tracing tests) shall be successfully completed.

C. All insulation shall be well secured to the item being insulated, by means of wire, clips, studs or other proven fasteners.

D. All fittings, flanges and valves shall be insulated with block, preformed or sectional insulation of the same material as adjacent pipe material, except on sizes up to 3-inch, two or more layers cemented in place may be used to obtain the required thickness of insulation.

E. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks and depressions shall be pointed with cement. When irregular or compound shapes require insulation be cut and fit, all gaps shall be filled. Cut and fit jacketing shall be free of jagged edges and shall provide complete coverage.

F. Insulation of any pipe line or any other item shall include insulation of all take-off connections (including those for instruments, controls, vents, drains or sampling) and all branch connections, up to and including the first valve in the take-off connection or branch connection.

G. Double layer insulation shall have staggered joints. Each layer shall be wired in place.

H. Insulation on vertical pipes shall have provisions which preclude eventual gaps in the insulation as a result of pipe expansion, settling, or shrinking of the insulation, or other causes. The provision may be intermediate supports, insulation “expansion joints” or other means approved by the Engineer.

I. All welding (including stud welding and other attachment on boiler, pressure vessels, piping systems and equipment) shall conform to applicable codes and standards.

J. At each pipe hanger or support, the insulation shall accommodate the hanger or supports and its anticipated movement.

K. Insulation work on all items (including boilers, pumps, vessels, etc.) shall conform to the requirements and recommendations of the respective manufacturers.

L. Insulation work of all of the following items shall be blankets which are designed to allow removal, reuse and replacement of the insulation work:

1. Flanges, 6-inch NPS or larger.

2. Manholes, handholes, and other access devices.

M. Insulation on heat traced pipe lines shall be such that the specified nominal thickness of insulation is uniformly maintained around the pipe.

N. The Contractor shall identify and insulate all Personnel Protection Areas and insulate as necessary in accordance with the following:

1. All points where personnel can easily come in contact with hot surfaces.

2. Areas are to include all hot surfaces within an elevation of 7-feet and with 2-feet of the sides of all access zones, walkways, platforms, working areas, or stairways and ladders.

O. Insulation Class DW shall be installed as noted in National Commercial & Industrial Insulation Standards - 1988, as published by Midwest Insulation Contractors Association. The method shown on plate 19 shall be used for interior ducts, and that shown on plate 20 shall be used for exterior ducts. Staple - stitching shall not be used.

P. Roof drain systems shall be insulated when located within any building.

Q. All external lines insulated above ground shall be enclosed with Class CG insulation and aluminum lagging. All external insulated lines belowground shall be enclosed with Class CG insulation and coated with Pittcote 300 and Pitwrap SSII.

R. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks, ends, and depressions shall be pointed with cement or mastic as recommended.

3.03 OWNER’S ACCEPTANCE

A. All materials, accessories, and methods of installation and fabrication are subject to the Owner’s inspection and approval during any phase of the Work.

3.04 PAINTING

A. All plumbing pipe, equipment, tank insulation shall be painted as required by Section 09900.

B. Pittcote 404 shall be installed by this Contractor with color selection by Owner.

3.05 PIPING INSULATION SCHEDULE

PIPE SYSTEMS	PIPE SIZE (INCH)	TYPE OF INSULATION	THICKNESS (INCH)	JACKET
Interior Domestic Hot Water Supply and Recirculation	1-1/4 and Smaller	Cellular Elastomeric Foam or Fiberglass	1.0	None
	1-1/2 and Larger	Cellular Elastomeric Foam	1.5	None
Interior Domestic Cold Water and NPW Supply	1-1/4 and Smaller	Cellular Elastomeric Foam	0.5	None
	1-1/2 and Larger	Cellular Elastomeric Foam	1.0	None
Exterior Domestic Hot and Cold Water Supply, Heat Traced	All Sizes	Cellular Elastomeric Foam or Fiberglass	2.0	Aluminum

END OF SECTION

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SECTION 15120
HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to hydronic specialties necessary for the completion of the Work in accordance with the Contract Documents.

1.02 PERFORMANCE REQUIRMENTS

A. Flexible Connectors: Provide at or near pumps or motorized where piping configuration does not absorb vibration.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.

c. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

d. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

e. Include electrical characteristics and connection requirements.

2. Information for the Record:

a. Operation and maintenance manual. Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.04 ELECTRICAL EQUIPMENT REQUIREMENTS

A. All equipment shall be powered by electrically and wired as required in Division 16.

1.05 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.
2. All hydronic specialties shall be accepted on site in factory packaging. Provide temporary protective coating on cast iron and steel valves. Inspect for damage.
3. Protect systems from entry of foreign materials by temporary covers, caps, and closures, completing sections of the work, and isolating parts of completed system until installation.

B. After Installation:

1. Protect installed hydronic specialties from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
2. Suitable covers shall be placed to protect against any specialties damage after it is installed and during the final days of construction.
3. Before acceptance, all covers and protective material shall be removed and the specialties cleaned and ready for use.

1.06 EXTRA MATERIALS

A. Provide one extra 55 gallon drum of propylene glycol.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers: H.O. Trerice Co., Model 450; Ametek U.S. Division; Ashcroft, Division of Dresser Industries, or equal.

B. Description: ASME B40.1 Grade 2A, liquid filled, with bourdon tube, rotary stainless steel geared movement, brass socket, front calibration adjustment, black scale on white background.

1. Fiberglass reinforced polypropylene case and threaded ring.
2. Window constructed of acrylic.
3. Bourdon tube constructed of phosphorous bronze.
4. 4-1/2” diameter aluminum dial face size with white background and black graduations and figures.
5. Mid-Scale Accuracy: - $\pm$ 1/2 percent accuracy full scale.
6. Scale in PSI, 0 to 60 psi specific range, 10 psi figure intervals, 0.5 psi minor divisions.

2.02 PRESSURE GAUGE TAPS

A. Connect pressure gauges with a pulsation dampeners upstream of a gauge cocks or needle valves.

B. Pulsation Dampener: Pressure snubbers, brass construction with 1/4-inch NPT connections, manufactured by Trerice, Series 872, or equal.

C. Gauge Cocks: Ball valve type with tee or lever handle, brass construction, for maximum 250 psig pressure, as manufactured by Trerice Series 865, or equal.

D. Needle Valves: Rising stem type with knurled dial or lever type handle, brass construction, as manufactured by Trerice Series 735, or equal.

E. Siphons: Schedule 40 steel, 1/4-inch NPT angle or straight pattern, as manufactured by Trerice Series 885, or equal.

2.03 THERMOMETERS

A. Dial Type Thermometers: 5-inch dial, bimetal type, with adjustable face, Trerice Model B856, Weiss Model 5VBM, Ashcroft 50AI60E, or equal, 20 to 240 degrees F range with thermometer supports.

B. Thermometer Supports:

1. Socket: Brass separable socket type for thermometer stems with or without extensions.

2. Flange: 3-inch outside diameter reversible flange, designed to fasten to sheet meatal air ducts, with brass perforated stem.

2.04 TEST PLUGS

A. Manufacturers: Sisco, Riverton, NJ; Autoflow; Griswold; Peterson; or equal.

B. 1/4-inch or 1/2-inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.

2. Nordel core for temperatures up to 350 degrees F.

3. Viton core for temperatures up to 400 degrees F.

C. Test kit shall consist of carrying case, internally padded, and fitted containing one 2-1/2-inch diameter pressure gage, two gage adapters with 1/8 inch probes, and one 1-/2-inch diameter dial thermometer.

2.05 FLEXIBLE CONNECTORS

A. Manufacturers: Mason Industries, Inc., Mercer Rubber Co., or equal.

B. Constructed of corrugated stainless steel inner hose with single layer of stainless steel exterior braiding, minimum 9 inches in length, on all steel piping systems. Connectors shall be line size or as noted on the Drawings with ends as required based on the piping material or as noted on the Drawings.

2.06 EXPANSION TANKS

A. Manufacturers: Bell & Gossett Model D-40, Armstrong, Taco, or equal.

B. Construction: Closed of welded steel construction, tested and stamped in accordance with ASME Section VIII, rated for working pressure of 125 psig; cleaned, prime coated, and supplied with steel support saddles; with taps for installation of accessories. Tank shall include gauge glass, cocks, and tank fittings.

C. Tank size as shown on the Drawings or specified within these Specifications.

D. Size:

1. Diameter: 16.25 inches.
2. Overall Length: 29 inches.
3. Capacity: 11.3 gallons.

2.07 AIR VENTS

A. Manufacturers: Bell & Gossett, Armstrong, Taco, or equal.

B. Manual Type: Short vertical sections 2-inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.

C. Float Type:

1. Cast iron body and cover, float, bronze pitot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.08 AIR SEPARATORS

A. Manufacturers: Bell & Gossett Model RL-4F, Armstrong, Taco, or equal.

B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.

C. In-Line Air Separators: Cast iron for sizes 1-1/2-inch and smaller, or steel for sizes 2-inch and larger; tested and stamped in accordance with ASME Section VIII; for 125 psig operating pressure and 350 degrees F. The air separator shall be painted with one shop coat of air dry enamel.

D. Furnish and install as shown on plans, a centrifugal type air separator, ITT Bell & Gossett, Armstrong, Taco, or equal. The unit shall have flanged inlet and outlet connections tangential to the vessel shell. Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter.

1. Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

2. The air separator(s) must be designed, constructed, and stamped for 125 psig at 350 degrees F in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one shop coat of light gray air dry enamel.

3. A Manufacturer's Date Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.

2.09 STRAINERS

A. Manufacturers: Watts Series LF777 & 77F, Hoffman Specialty, Mueller, or equal.

B. Size 2-Inches and Under: Screwed brass, bronze, or iron body for 175 psig working pressure. Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2-Inches to 4 inches: Flanged iron body for 175 psig working pressure, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5-Inches and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.10 PUMP SUCTION FITTINGS

A. Manufacturers: Bell & Gossett, Armstrong, Taco, or equal.

B. Fitting: Angle pattern, cast iron body. Threaded for 2 inch and smaller, flanges for 2-1/2 inch and larger. Rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blow-down tapping in bottom, gage tapping in side.

2.11 COMBINATION PUMP DISCHARGE VALVE

A. Manufacturers: Bell & Gossett, Armstrong, Taco, or equal.

B. Valves: Straight or angle pattern, flanged cast iron valve body with bolt on bonnet for 175 psig operating pressure, non-slam check valve with spring loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.12 MANUAL BALANCE VALVES

A. Manufacturers: Bell & Gossett Model CB, Armstrong, Taco, or equal.

B. Calibrated Balance Valve (1/2 Inch – 3 Inch): Valve body constructed of lead free brass with ball valve constructed of Type 304 stainless steel. NPT threaded or ANSI 125 LB flanged end connections.

C. Calibrated Balance Valve (2-1/2 Inch – 4 Inch): Valve body constructed of cast iron rated for 175 psig working pressure with ball valve constructed of brass. NPT threaded or ANSI 125 LB flanged end connections.

D. Calibrated Balance Valve (4 Inch – 12 Inch): Valve body constructed of cast iron for 175 psig with multi-turn globe style valve, include a brass disc with a soft seat design made of EPDM. ANSI 125 LB flanged end connections.

E. Manual balance valves shall include the following:

1. Two pressure/temperature ports.
2. Drain valve port.
3. Calibrated nameplate with memory stop with position indicator from 0 to 100 percent.
4. Reduced port design providing velocity head recovery.
5. Temperature Range: -4 degrees F to 250 degrees F.

2.13 FLOW CONTROLS

A. Manufacturers: Tour & Anderson, Inc., Mt. Laurel, NJ, Bell & Gossett, Armstrong or equal.

B. All balancing valves shall be of globe style design to offer the widest range of adjustment accuracy in the flow rate. All balancing valves must offer a minimum of 360 degrees rotation of the handwheel for accurate adjustments and acceptable control range.

1. All balancing valves shall exhibit an accuracy in flow measurement of plus or minus 5% in the normal operating range of the valve.
2. All balancing valves shall have provisions for measuring differential pressure, flow rates, flow temperature. Also to include air venting as an integral part of the valve body.
3. All balancing valves must offer 100% positive, leakproof shutoff against the same fluid pressure as the valve body pressure rating.
4. All balancing valves in sizes 1/2-inch to 2-inch shall have a digital handwheel for display and presetting accuracy. A drain/fill connection with integral stop valve shall also be included on sizes up to 1-1/2-inch. Sizes 2-1/2-inch to 12-inch shall have a ring scale sleeve under the handwheel for reading.

5. All balancing valves in sizes 1/2-inch to 2-inch shall be shipped in a container which shall be used as insulation after valve installation. The flame-retardant insulation shall have an "R" value of 4.5. (Option) insulation shall also be provided on all sizes 2-1/2-inch to 6-inch flanged.

6. All balancing valves in sizes 1/2-inch to 2-inch shall be manufactured from dezincification resistant copper alloy which does not require dielectric fittings. Valves in sizes 2-1/2-inch to 12-inch shall be manufactured from a cast iron equivalent to ASTM 35B.

7. For valve sizes 1/2-inch NPT to and including 12-inch flanged the nominal ratings shall be 250 psi at 250 degrees F.

2.14 THERMOSTATIC CONTROL VALVE (RADIATOR VALVE)

A. Manufacturers: Tour & Anderson, Mt. Laurels, NJ, RVT 321 or RVT 324, American Steam or equal.

B. Valve: Self-contained, non-electric, thermostatic valve for individual area or room control. Valve body shall be angle or straight pattern, inside screw globe valve for 125 psig working pressure, with bronze and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lock shield key cap and set screw memory bonnet for balancing service as shown on the Drawings.

C. Provide attached or remote sensor and adjustment as shown on the Drawings. Manufacturers shall be Tour & Anderson RVT 341 or RVT 346 respectively, American Steam, or equal. Capillary tube length shall be provided as required by the Drawings.

2.15 RELIEF VALVES

A. Manufacturers: Bell & Gossett, Armstrong, Taco, or equal.

B. Construction: Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities, ASME certified and labeled.

2.16 PRESSURE REDUCING VALVES

A. Manufacturers: Bell & Gossett Model B7, Armstrong, Taco, or equal.

B. Pressure reducing valves shall be diaphragm operated with brass body, low inlet pressure check valves and inlet strainer. The strainer must be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material. 125 psig maximum working pressure. 12 psi set pressure.

2.17 GLYCOL FEED SYSTEM

A. Manufacturers: Neptune Model G-50-1, J.L Wingert Co., Budzar Industries, Inc., or equal.

B. Type: Automatic glycol feed package system consisting of a polyethylene tank with polyethylene lid/cover, carbon steel frame, NEMA 4X control panel, low level float switch, open motor bronze rotary pump with internal relief valve, pressure switch, relief valve, check valve, Schedule 80 PVC piping and vinyl braided hose.

C. Tank and Frame: Industrial grade 50 gallon polyethylene tank with a nominal wall thickness of 1/4-inch and a shoebox type lid. Tank frame constructed of carbon steel with bracing for piping and control panel. Tank frame shall include a 12 gauge pump mount shelf and be coated with water based enamel paint.

D. Pump: Close coupled bronze rotary gear pump with internal pressure relief valve. Open drip proof type pump motor wired to control panel.

1. Flow: 1.5 GPM.
2. Head: 100 PSI.
3. Motor (HP): 1/3.
4. Electrical (V/PH/HZ): 120/1/60 unless stated otherwise in Division 16.

E. Pressure Switch: Pressure switch prewired to the control panel to turn pump on and off based on rising and falling pressure settings.

1. Cut-In Pressure: 10-45 psi.
2. Cut-Out Pressure: 20-60 psi.
3. Adjustable Pressure Differential: 10-30 psi.

F. Control Panel: Polycarbonate NEMA 4X control panel of ample size for equipment needed and servicing of electrical components. All exterior components rated NEMA 4X and installed per manufacturers instructions. Wiring and wiring diagram shall be color coded for easy trouble shooting. All internal wiring shall be 16 gauge minimum. Controls are, but not limited to, main power switch and indicator light, pump hand/off/auto switch and indicator light, and red low level indicator light.

G. Pressure Relief Valve: Pressure relief valve constructed of bronze with a nitrile diaphragm.

H. Check Valve: Back flow check valve of soft seat design. Bronze construction with stainless steel spring and raised radius valve seat for positive seal installed on pump discharge piping.

I. Low Level Switch: Polypropylene low level float type switch interlocked with pump feed and low level indicator. Low level stops all pump operations when level falls below the factory set point.

J. Accessories: Unit shall be provided with pre-piped PVC ball type shut-off valves on both the pump suction and discharge piping, cast iron Y-strainer on pump suction, and a 0-100 psi pressure gauge on pump discharge. Provide flexible connections on both the suction and discharge piping of the pump.

2.18 GLYCOL SOLUTION

A. Manufacturers: Dow Chemical Company, or equal.

B. Corrosion inhibited, propylene glycol and water solution mixed 50 percent glycol and 50 percent water, suitable for operating temperatures from -40 degrees F to 250 degrees F.

C. FDA approved.

D. Accessories shall include testing kit for determining glycol concentration.

PART 3 EXECUTION

3.01 INSTALLATION – THERMOMETERS AND GAUGES

A. Install thermometers and gauges in accordance with manufacturer's instructions.

B. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gauge.

C. Install gauge taps in piping.

D. Install pressure gauges with pulsation dampers/pressure snubbers. Provide needle or ball valve to isolate each gauge. Extend nipples to allow clearance from insulation.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer socket. Allow clearance from insulation.

F. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees of vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 INSTALLATION – HYDRONIC PIPING SPECIALTIES

A. Install specialties in accordance with manufacturer's instructions.

B. Locate test plugs as indicated on the Drawings.

C. Install manual air vents at system high points and as indicated.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of centrifugal pumps where indicated.

H. Support pump fittings with floor-mounted pipe and flange supports.

I. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.

J. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Set equipment relief valve capacity to exceed rating of connected equipment.

L. Pipe relief valve outlet to nearest floor drain.

M. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

N. Clean and flush glycol system before adding glycol solution.

O. Feed glycol solution to system through make-up line pressure regulator, venting system high points. Set to fill at 12 psig. Pressure system cold at 5 psig.

P. Perform tests determining strength of glycol and water solution and submit written test results.

3.03 TEMPORARY STRAINERS

A. Where strainers are not identified on the Drawings, the Contractor shall furnish a temporary cone strainer as shown on the Drawings. The strainer is to have 100 mesh lining. The installation shall include a spool piece as necessary for ease of removal. The strainer shall be installed and removed as noted herein.

B. If pressure gauges are not available as a part of the installation, then the Contractor is to provide and install the minimum number of temporary gauges necessary to monitor each part of the fluid process in order to identify the pressure drop across each filter. Locations are to be approved by the Engineer. The system(s) are to be shut down, the strainer gaskets cleaned, and restarted until the system can operate for 4 to 8 hours as determined by the Engineer without having to stop and clean the strainer gasket. The Contractor may then remove the temporary strainer and install a new permanent gasket as specified.

3.04 ACCEPTANCE

A. The working temperature and pressure conditions shall be imposed on piping systems for a sufficient length of time to ensure that flanges and bolts or studs have reached a

point of constant temperature and have attained such changes in dimensions as will take place, after which all flanged joints and fittings on all equipment shall be retightened by the Contractor.

B. Where system operating temperature is above 200 degrees F, joints shall be retightened after 200 hours of service at operating conditions.

3.05 FIELD QUALITY CONTROL

A. Test for strength of glycol and water solution and submit written test results.

3.06 CLEANING

A. Clean and flush glycol system before adding glycol solution.

B. Upon completion of installation, steam, condensate, hot water, and condenser water systems constructed of ferrous materials shall be thoroughly cleaned by circulating 10% caustic solution through systems for four hours after which systems shall be flushed out with clean water and repeated a second time.

C. Systems shall be washed out, as prescribed, a third time after operation for three weeks and repeated as many more times as may be necessary to remove all oil, dirt, and grease from systems.

D. Upon completion of installation of water based systems constructed of copper and brass materials, the systems shall be thoroughly cleaned by circulating a non-corrosive chemical such as Mitco BL-5 furnished by Mitco Water Treatment of Grand Rapids, MI, 616-241-4684, or equal, partially drained and recharged, circulated for six hours, flushed until clear as required by the Vendor.

E. The system shall be refilled immediately with water and a corrosion inhibitor as prescribed by Mitco, or equal.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not install hydronic pressure gages until after systems are pressure tested.

3.08 CONCRETE

A. The contractor shall furnish and install all concrete and reinforcing steel necessary to complete the electrical work, including foundations and all materials for concrete and reinforcing steel work wherever required. All concrete and concrete reinforcement used in the Work shall conform in quality of ingredients, mixture, strength, method of installation and workmanship to the requirements specified in Section 03300 of specifications.

3.09 MOUNTING AND ATTACHMENT

A. The Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten all equipment and materials to be installed on or in concrete bases or structures which are existing or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

3.10 NUTS AND BOLTS

A. All nuts and bolts used under this Section shall be (Type 304 stainless steel or higher grade) as specified or shown on the Drawings.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15130
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to HVAC centrifugal pumps and appurtenances necessary for the completion of the Work in accordance with the Contract Documents.

1.02 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent or midpoint of published maximum efficiency curve.

B. Motors shall be UL approved and constructed to NEMA standards.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Include certified pump curves showing performance characteristics with pump and system operating point plotted, weights, furnished specialties, and accessories.

c. Include NPSH curve when applicable.

d. Include electrical characteristics and connection requirements, wiring diagrams, manufacturer model number, materials of construction, dimensions, service sizes, and finishes.

2. Information for the Record:

a. Operation and maintenance manual. Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.04 ELECTRICAL EQUIPMENT REQUIREMENTS

A. All equipment shall be powered by electrically and wired as required in Division 16.

1.05 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All pumps and appurtenances shall be accepted on site in factory packaging. Inspect for damage.

3. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts to be completed.

B. After Installation:

1. Protect installed pumps from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any specialties damage after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the specialties cleaned and ready for use.

PART 2 PRODUCTS

2.01 RESERVED

2.02 VERTICAL IN-LINE PUMPS

A. Manufacturers: Bell & Gossett, Series e-80, Armstrong, Taco, or equal.

B. Type: Vertical, single-stage, close-coupled, radially or horizontally split casing, for in-line mounting, for 175 psig maximum working pressure.

C. Casing: Cast iron, with suction and discharge gage port, drain plug, flanged suction and discharge, provisions for internal flushing of seal.

D. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

E. Shaft: Carbon steel with stainless steel impeller cap screw.

F. Shaft Sleeve: Aluminum bronze.

G. Seal: Packing gland with minimum four rings graphite impregnated packing and lantern ring, 250 degrees F maximum continuous operating temperature.

H. Electrical Characteristics:

1. Motors: 1750 rpm unless indicated otherwise.

2. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.03 RESERVED

PART 3 EXECUTION

3.01 PREPARATON

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

C. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

D. Install pumps on vibration isolators.

E. Install flexible connectors at or near pumps where piping configuration does not absorb vibration.

F. Provide line sized shut-off valve and strainer on pump suction, and line sized shut-off valve and combination pump discharge valve on pump discharge.

G. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

H. Provide air cock and drain connection on horizontal pump casings.

I. Provide drains for bases and seals.

J. Check, align, and certify alignment of base mounted pumps prior to start-up.

K. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

L. Provide access space around pumps for service. Provide no less than minimum as instructed by manufacturer.

M. Provide suction diffuser with all base-mounted pumps.

N. Lubricate pumps before start-up.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15180
HYDRONIC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Heating water piping, above ground.
2. Glycol piping, above ground.
3. Equipment drains and overflows.
4. Unions and flanges.
5. Pipe hangers and supports.
6. Valves.
7. Bedding and cover materials.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B31.9 - Building Services Piping.
6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM B32 - Standard Specification for Solder Metal.
3. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment, or other apparatus.

C. Provide pipe hangers and supports in accordance with ASME B31.9, MSS SP 58, MSS SP 69, and MSS SP 89.

D. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.

F. Use spring loaded check valves on discharge of hot water pumps.

G. Use plug valves for throttling service. Use non-lubricated plug valves only when shut-off or isolating valves are also provided.

H. Use butterfly valves in heating water and chilled water systems interchangeably with gate and globe valves.

I. Use only butterfly valves in chilled water systems for throttling and isolation service.

J. Use lug end butterfly valves to isolate equipment.

K. Use 3/4-inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

L. Flexible Connectors: Use on both the suction and discharge piping at pumps or motor driven equipment where piping configuration does not absorb vibration.

1.04 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Indicate schematic layout of heating piping system, including equipment, critical dimensions, and sizes.

b. Product Data: Submit manufacturers published literature data on pipe materials, fittings, and accessories.

2. Product Data:

a. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

b. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

c. Hangers and Supports: Submit manufacturers catalog information including load capacity.

3. Test Reports: Indicate results of heating piping system pressure test.

4. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

5. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

6. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

B. Information for the record:

1. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

2. Substantiation of vendor compliance with codes, standards, or test methods noted herein.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with applicable authority and AWS D1.1 for welding hanger and support attachments to building structure.

1.06 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the requirements of Section 01350 concerning transporting, handling, storing, and protecting products.

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

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

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

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 COORDINATION

A. Coordinate trenching, excavating, bedding, backfilling of buried piping systems with requirements of Section 02200.

PART 2 PRODUCTS

2.01 RESERVED

2.02 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375-inch wall for sizes 12 inch and larger, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.

2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.03 RESERVED

2.04 RESERVED

2.05 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

2.06 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Gaskets: 1/16-inch-thick preformed neoprene gaskets.

2.07 GATE VALVES

A. Manufacturers:

1. Nibco.
2. Crane.
3. Conbraco.
4. Or equal.

B. 2 inches and Smaller: MSS SP 80, Class 125 , bronze body, bronze trim, threaded union bonnet, rising stem, hand-wheel, inside screw with back-seating stem, solid split wedge disc, alloy seat rings, solder or threaded ends.

C. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.08 GLOBE VALVES

A. Manufacturers:

1. Nibco.
2. Crane.
3. Combraco.
4. Or equal.

B. 2 inches and Smaller: MSS SP 80, Class 125 , bronze body, bronze trim, threaded union bonnet, hand wheel, Buna-N .

C. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.09 BALL VALVES

A. Manufacturers:

1. Nibco.
2. Crane.
3. Conbraco.
4. Or equal.

B. 2 inches and Smaller: MSS SP 110, Class 150 Stainless steel, two piece body, stainless steel ball, teflon seats and stuffing box ring, threaded ends, locking lever handle with balancing stops.

2.10 PLUG VALVES

A. Manufacturers:

1. Crane.
2. Flowserve/Nordstrom.
3. Val-Matic.
4. Or equal.

B. 2 inches and Smaller: MSS SP 78, Class 150, semi-steel construction, round port, regular opening, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

C. 2-1/2 inches and Larger: MSS SP 78, Class 150, semi-steel construction, round port, regular opening, pressure lubricated, teflon packing, flanged ends. Furnish worm gear-operated.

2.11 BUTTERFLY VALVES

A. Manufacturers:

1. Nibco.
2. Crane.
3. Hammond.
4. Milwaukee.

5. Or equal.

B. 2-1/2 inches and Larger: MSS SP 67, Class 150.

1. Body: Cast or ductile iron, wafer ends, stainless steel stem, extended neck.
2. Disc: stainless steel.
3. Seat: Resilient replaceable Buna N.
4. Handle and Operator: 10 position lever handle.

2.12 PIPE HANGERS AND SUPPORTS

A. Furnish materials in accordance with State or Municipality of standards.

B. Conform to ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2-1/2 inches and Larger: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.

F. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

H. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.

I. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

J. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.

K. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.

L. Vertical Support: Steel riser clamp.

M. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

O. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

P. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.

Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

R. Inserts: Malleable iron case of [galvanized] steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.13 BEDDING AND COVER MATERIALS

A. Unless otherwise shown on the Drawings or specified herein, all pipe bedding and cover material shall be in conformance with Section 02200.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

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

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

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 {15185}.

3.03 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut [above] [flush with top of] [recessed into and grouted flush with] slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.9,ASTM F708,and MSS SP 89.

B. Support horizontal piping as scheduled.

C. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every [other] floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Provide [copper plated hangers and supports for copper piping] [sheet lead packing between hanger or support and piping].

I. Prime coat exposed steel hangers and supports. [Refer to Section 09 90 00 {09900}.] Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

****** [OR] ******

K. Install pipe hangers and supports in accordance with Section 15061.

3.05 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install glycol, condenser water, and exhaust piping in accordance with ASME B31.9. Install heating water piping in accordance with ASME B31.1 ASME B31.9.

B. Route piping parallel to building structure and maintain gradient.

C. Install piping to conserve building space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install pipe identification in accordance with Section 15075.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide access where valves and fittings are not exposed.

H. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

J. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09900.

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

L. Insulate piping refer to Section 15081.

3.06 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements, 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test heating water piping system glycol piping system in accordance with ASME B31.9 ASME B31.1.

3.07 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

Pipe Size Inches	Copper Tubing Maximum Hanger Spacing Feet	Steel Pipe Maximum Hanger Spacing Feet	Copper Tubing Hanger Rod Diameter Inches	Steel Pipe Hanger Rod Diameter Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 1)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8

C. Plastic and Ductile Iron Pipe Hanger Spacing:

Pipe hanger spacing		
Pipe Material	**Maximum Hanger Spacing Feet**	**Hanger Rod Diameter Inches**
ABS (All sizes)	4	3/8
FRP (All Sizes)	4	3/8
Ductile Iron (Note 2)		
PVC (All Sizes)	4	3/8

D. Note 1: Refer to manufacturer’s recommendations for grooved end piping systems.

E. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch

connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

END OF SECTION

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SECTION 15185
CHEMICAL WATER TREATMENT EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. This section includes furnishing all materials, equipment, labor, and supervision related to the following:

1. System cleaner.
2. Closed system treatment (water).
3. Chemical feeder equipment including associated feeders, pumps, tanks, controls, meters and valves.
4. Test equipment.

B. The completion of the Work in accordance with the Contract Documents.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

E. Provide and install all equipment specified within this Section.

F. Additional product requirements are specified in Section 01350.

1.02 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
   a. Indicate system schematic, equipment locations, and controls schematics, electrical characteristics, and connection requirements.
2. Product Data:
   a. Submit chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

3. Manufacturer's Installation Instructions: Submit placement of equipment in systems, piping configuration, and connection requirements.

4. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

5. Manufacturers Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

B. Information for the Record:

1. Operation and Maintenance Data: Submit data on procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with State or Municipality of standard for addition of non-potable chemicals to building systems and for discharge to public sewers.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project with water analysis laboratories and full-time service personnel.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.07 MAINTENANCE SERVICE AND MATERIALS

A. Furnish monthly technical service visits, for one year starting at Date of Substantial Completion, to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements and corrective actions needed. Submit two copies of field service report after each visit.

B. Furnish laboratory and technical assistance services during this maintenance period.

C. Furnish on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program and make recommendations in writing based upon these inspections.

D. Furnish chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.01 MATERIALS

A. System Cleaner:

1. Product Description: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tri-Poly phosphate and sodium molybdate.

2. Biocide; chlorine release agents including sodium hypochlorite or calcium hypochlorite, or microbiocides including quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water):

1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.

2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulfites.

3. Conductivity enhancers; phosphates or phosphonates.

2.02 BY-PASS (POT) FEEDER

A. Manufacturers:

1. Claypool, Inc.

2. Mogul.

3. Venture VI.

4. Vulcan-Clow.

5. Or equal.

B. Provide 1-1/2 gallon capacity, manual, quick opening cap for working pressure of 175 psig, furnished with funnel, inlet valve, vent cock and drain cock.

2.03 RESERVED

2.04 TEST EQUIPMENT

A. Furnish white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titration burettes and associated reagents.

B. Furnish following test kits:

1. Alkalinity titration test kit.

2. Chloride titration test kit.

3. Sulphite titration test kit.
4. Total hardness titration test kit.
5. Low phosphate test kit.
6. Conductivity bridge, range 0 - 10,000 micro-ohms.
7. Creosol red pH slide, complete with reagent.
8. Portable electronic conductivity meter.
9. High nitrite test kit.

PART 3 EXECUTION

3.01 PREPARATION

A. Operate, fill, start and vent systems prior to cleaning. Use water meter to record capacity in each system. Place terminal control valves in open position during cleaning.

3.02 CLEANING

A. Concentration:
   1. As recommended by manufacturer.
   2. One pound per 100 gallons of water contained in the system.
   3. One pound per 100 gallons of water for hot systems and one pound per 50 gallons of water for cold systems.
   4. Fill steam boilers only with cleaner and water.

B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
   2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until system cleaner is removed.

3.03 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and interconnecting piping. Install around balancing valve downstream of circulating pumps as indicated on the drawings.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Install 3/4-inch water coupon rack around circulating pumps with space for 4 test specimens.

3.04 RESERVED

3.05 DEMONSTRATION

A. Furnish one four-hour training course for operating personnel, instruction to include installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

B. The Contractor shall provide for the cost and make arrangements for the services of a water treatment consultant/sales representative who, with the Contractor, will provide the function listed below. The Engineer will be involved in the representative selection by the submittal process.

1. Provide a sampling and chemical addition procedure that prohibits deposit within the system, prevents corrosion, controls foaming, and controls suspended solid matter within the range specified herein, for each system.
2. Provide operator operational checklist for daily or as necessary repetitive tasks which will identify all test and chemical adjustments made.
3. Train Owner's authorized representative in the proper techniques for testing and chemical additions in a safe and economical manner.
4. Provide training materials and instructional brochures.
5. Provide the necessary beakers, flasks, stir rods, filter paper, litmus paper, racks, and storage cabinet, cylinders, chemicals, and burettes as necessary to make the necessary tests for each system.
6. Determine blowdown quantities, duration, and repetition as necessary for each system and make reporting of same part of the operator checklist(s).
7. Be on-site a minimum of once monthly to perform any or part of the functions identified in this Section with the Owner's representative.
8. Provide a written report of each visit with a triplicate copy to the Engineer. This report to include copies of each daily (or as necessary) checklist made between dates of the monthly visits.
9. Provide for one year's worth of chemicals required for each of the steam and/or water systems.

C. Water quality requirements for closed type heating systems:

	Hot Water		**Steam**	
	140 to 250 F**	**250 to 350 F**	**5 to 250 psig**	**250 to 500 psig**
Total Hardness	10	5	0	0
Alkalinity		300 to 700	300 to 700	300 to 500

	Hot Water		Steam	
	140 to 250 F**	**250 to 350 F**	**5 to 250 psig**	**250 to 500 psig**
pH	17.5 to 10.0	8.0 to 10.0	10.5 to 11.5	10.5 to 11.0
Silica	150	125	125	50 to 90
Dissolved Solids			2500 to 3000	2000 to 2500
Suspended Solids			300 to 600	150 to 300
Dissolved Oxygen	0.015	0.015	0.015	0.007
Sodium Sulfite			30 to 60	30 to 60
Phosphate			40 to 80	20 to 50
Oil	1.0	1.0	1.0	0.1
Iron	1.0	1.0	0.1	0.1
Organic	0	0	0	0

* All values in mg/L or ppm except pH.
** Also for chilled water and condenser water.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15195
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Natural gas piping buried within 5 feet of building.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.
6. Strainers.
7. Natural gas pressure regulators.
8. Natural gas pressure relief valves.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
4. ASME B31.9 - Building Services Piping.
5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

E. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

G. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

1.03 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

D. Use plug, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.04 SUBMITTALS

A. Submittals shall be accordance with the requirements of Section 01300 and include the following.

1. Product Data:

a. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

b. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

c. Hangers and Supports: Submit manufacturers catalog information including load capacity.

d. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:

1) Strainers.

2) Natural gas pressure regulators.

3) Natural gas pressure relief valves.

2. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

3. Test Reports: Indicate results of piping system pressure test.

4. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

5. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

B. Information for the record:

1. Manufacturer’s Installation Instructions: Submit manufacturer’s published literature indicating proper installation procedures.

2. Substantiation of vendor compliance with codes, standards, or test methods noted herein.

3. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.05 QUALITY ASSURANCE

A. Perform natural gas Work in accordance with NFPA 54.

B. Perform work in accordance with applicable code and local gas company requirements.

C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

D. Perform Work in accordance with applicable code and authority having jurisdiction [AWS D1.1] for welding hanger and support attachments to building structure.

E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

F. Perform Work in accordance with State of Michigan standard.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design piping system, hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location in State of Michigan.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Section 01350 – Common Product Requirements: Product storage and handling requirements.

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

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.09 COORDINATION

A. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems with the requirements of Section 02200 – Excavation and Backfill.

1.10 EXTRA MATERIALS

A. Furnish two packing kits for each type and size valve.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M forged steel welding type.

2. Joints: ASME B31.9, welded.

3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. High Density Polyethylene (HDPE) Pipe and Fittings:

1. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications. Qualified manufacturers shall be: PLEXCO Division of Chevron Chemical Company, DRISCOPIPE as manufactured by Phillips Products Co., Inc., SCLAIRPIPE as manufactured by DuPont of Canada or equal as approved by the Utilities Engineer.

2. Materials For Pipe Sizes 2-Inch Diameter and Less:

    a. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 4710 high density polyethylene IPS-SDR 11 resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type lll, Class C, Category 5, Grade P34 per ASTM D1238.

    b. High Density Polyethylene (HDPE) pipes shall comply with AWWA Specifications C901.

    c. Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

    d. HDPE pipe and accessories 2” and less in diameter, shall be 160 psi at 73.4o F meeting the requirements of Standard Dimension Ration (SDR) 9 as MINIMUM STRENGTH.

3. Fittings:

    a. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

    b. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

    c. All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. NO size on size wet taps shall be permitted.

    d. All transition from HDPE pipe to ductile iron or PVC shall be made per the approval of ASPA Engineer and per the HDPE pipe manufacturer’s recommendations and specifications. A molded flange connector adapter within a carbon steel back-up ring assembly shall be used for pipe type transitions. Ductile iron back-up rings shall mate with cast iron

flanges per ANSI B16.1. A 316 stainless steel back-up ring shall mate with a 316 stainless steel flange per ANSI B16.1.

1) Transition from HDPE to ductile iron fittings and valves shall be approved by ASPA Engineer before installation.

2) No solid sleeves shall be allowed between such material transitions.

3) Fittings and transitions shall be as manufactured by Phillips DRISCOPIPE, Inc., 1000 Series Pressure Pipe, Chevron Chemical Company Plexco/Spiralite pipe, or equal.

2.02 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.

2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.03 REGULATOR VENT PIPING, ABOVE GRADE

A. Indoors: Same as natural gas piping, above grade.

B. Outdoors: PVC pipe, tubing, and fittings, UL 651.

2.04 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.

2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.

2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.05 RESERVED

2.06 PLUG VALVES

A. Manufacturers:

1. Nordstrom Two-Bold Cover-Type Iron Plug Valve.

2. Or approved equal.

B. Type: Lubricated plug valve providing drop tight shut-off for use with natural gas service.

C. Plugs: Solid one-piece, cast iron ASTM A 126 Class B. Cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90 percent closed.

D. Body: Cast iron ASTM A126 Class B.

E. Plug and Stem: Cast iron ASTM A126 Class B.

F. Pressure Ratings: 200 psig on valve sizes through 5 inch. Every valve shall be given a certified hydrostatic shell test and seat test, with test reports being available upon request.

G. End Connections: Flanged drilled per ASME B16.1.

H. Actuator: Manual wrench-operated valves. Furnish one plug valve wrench.

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 PIPE HANGERS AND SUPPORTS

A. Furnish materials in accordance with State or Municipality standards.

B. Conform to NFPA 54, ASME 31.9, MSS SP 58, MSS SP 69, and MSS SP 89.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.

D. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Wall Support for Pipe 3 inches and Smaller: Cast iron hook.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Sheet Lead: ASTM B749, 2.5 lb./sq ft, 0.039 inch thick.

2.11 STRAINERS

A. Manufacturers:

1. Keckley Company.

2. Or equal.

B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.

C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

D. 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.12 NATURAL GAS PRESSURE REGULATORS

1. Manufacturers: Fisher Regulators Or approved equal

B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.

1. Comply with ANSI Z21.80.
2. Temperatures: minus 20 degrees F to 150 degrees F.
3. Body: Cast iron.
4. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
5. Disk, diaphragm, and O-ring: Nitrile
6. Maximum inlet pressure: 150 psig.
7. Furnish sizes 2 inches and smaller with threaded ends.
8. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.13 RESERVED

2.14 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, [clear] [brightly colored] plastic covering, imprinted with "Natural Gas Service” in large letters.

2.15 RESERVED

PART 3 EXECUTION

3.01 EXAMINATION

A. 01300 - Administrative Requirements: Coordination and project conditions.

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

3.02 PREPARATION

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

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

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

3.03 INSTALLATION – INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut [above] [flush with top of] [recessed into and grouted flush with] slab.

3.04 INSTALLATION – PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with [ASME B31.9] [ASTM F708] [and] [MSS SP 89].

B. Support horizontal piping hangers as scheduled.

C. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every [other] floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Provide sheet lead packing between hanger or support and piping.

I. Prime coat exposed steel hangers and supports in accordance with Section 09900. Finish paint exposed steel hangers and supports in accordance with Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.05 RESERVED

3.06 INSTALLATION – ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

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

C. Route piping in orderly manner and maintain gradient.

D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.

E. Install piping to conserve building space and not interfere with use of space.

F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

J. Provide clearance for installation of insulation and access to valves and fittings.

K. Provide support for utility meters in accordance with requirements of utility company.

L. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood. Protect vent against entry of insects and foreign material.

1. Minimum Vent Size: Connection size at regulator vent connection.

2. Run individual vent line from each relief device, independent of breather vents.

M. Breather vents may be manifolded together with piping sized for combined appliance vent requirements.

N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09900.

O. Install identification on piping systems including underground piping.

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

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

R. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.

3.07 FIELD QUALITY CONTROL

A. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.

B. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.

C. Pressure test natural gas piping in accordance with NFPA 54.

D. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.

E. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

F. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.

G. Where leakage is detected, shut off gas supply until necessary repairs are complete.

H. Do not place appliances in service until leak testing and repairs are complete.

3.08 SCHEDULES

A. Pipe Hanger Spacing:

Pipe Size Inches	Copper Tubing Maximum Hanger Spacing Feet	Steel Pipe Maximum Hanger Spacing Feet	Copper Tubing Minimum Hanger Rod Diameter Inches	Steel Pipe Minimum Hanger Rod Diameter Inches
1/2	4	6	3/8	3/8
3/4	6	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	8	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	8	10	1/2	½
3	8	10	1/2	½
4	8	10	1/2	5/8
5	8	10	1/2	5/8
6	8	10	5/8	¾
8	8	10	3/4	¾

3.09 OWNER'S ACCEPTANCE

A. All materials, accessories, and methods of installation and fabrication are subject to the Owner's inspection and approval during any phase of the Work.

PART 4 SPECIAL PROVISIONS

4.01 PIPING SERVICE MATERIAL REQUIREMENTS

A. The following are the material classifications to be used for the piping service identified.

Service	Piping	Gaskets
Natural Gas (NG)	Black Steel Pipe SCH 40	N/A
Natural Gas (NG), Buried	PE 4710 HDPE IPS-SDR 11	N/A

END OF SECTION

SECTION 15211
SMALL PIPING AND VALVES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all pipelines and valves less than 4-inch in diameter as shown on the Drawings or as required for a complete piping system for each service or combination of services.

B. Each piping system shall be adequate to conduct and control the flow of process water, plant water, non-potable water, instrument air, compressed air, vacuum, natural gas, sewage gas, propane, fuel oil, chemicals, sewage, sludge, sampling or other uses as specified or shown on the Drawings.

C. This Section includes, but is not limited to:

1. Securing and bearing the cost of all permits, certificates, and inspection as required by local regulations and state codes.
2. All pipe, fittings, and connections for water supply to equipment and waste to drains.
3. Valves less than 4-inch in diameter, control devices, pipe hangers, anchors, supports, and sleeves for the piping systems covered under this Section.
4. Hose bibbs, sill cocks, and hydrants.
5. Non-potable water supply, drain lines, and connections to boilers, pump priming systems, pump gland seals, valve operating cylinders, or other equipment requiring these services.
6. Compressed air piping, valves, connections to valve operators, and other equipment requiring compressed air.
7. Compressed air, non-potable water, natural gas, propane, vacuum, deionized water, and other services as required for laboratory service.

D. The Contractor shall furnish, install, and remove all temporary piping and valves that are required to maintain processes in operation during construction.

E. All wall, floor, and roof penetration and any building modifications which are required for the installation of the Work under this Section shall be included in this Section.

F. Instruments which are to be located in pipelines to be furnished under Division 16 shall be installed under this Section.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Drawings shall include plan dimensions to and elevations of sleeves, inserts, and anchors, the size and location of each run of pipe, and the location of valves and unions.

b. Manufacturer's literature, catalog data, specifications, and illustrations shall be bound in a brochure which includes a complete bill of materials.

2. Information for the Record:

a. Operation and maintenance manual.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Cast Iron Soil Pipe for exterior and buried conduits shall conform to ASTM A74 service grade. Rubber gaskets for compression joints and hubless joints shall conform to ASTM C564. Cast iron soil pipe 2-inch diameter and larger shall be used for buried conductors from toilet fixtures; floor, roof, equipment, and area drains; and similar services unless otherwise shown on the Drawings or specified. Buried pipe shall be coated inside and out and interior piping shall be coated inside with nonbrittle coal tar pitch paint. Threaded openings shall not be coated. Double bell fittings shall not be used.

B. Ductile Iron Pressure Pipe (DIP):

1. Ductile Iron Pressure Pipe (DIP) shall conform to ANSI A21.51 or AWWA C151 and shall be pressure class 350 psi for sizes 12-inch and below, and pressure class 300 psi for larger sizes unless otherwise specified herein. Mechanical joint fittings shall be ductile iron and conform to ANSI A21.10 or AWWA C110 and ANSI A21.53 or AWWA C153. Flanged fittings shall be ductile iron and conform to ANSI A21.15 or AWWA C115. All fittings shall have a pressure rating of 250 psi for all pipe sizes unless otherwise specified.

2. Ductile iron pipe buried underground, unless otherwise specified or shown, shall have rubber gasket (slip-on) type joints in straight runs and mechanical joints with retainer glands each way from bends as shown on the Drawings. The gasket shall be a single molded rubber ring fitted into a specially shaped recess in the bell forming a pressure tight seal. The spigot end of each pipe shall be marked to indicate when the pipe is "home." Fittings shall have mechanical joints with retainer glands unless otherwise specified or shown. Retainer glands shall be ductile iron. The restraining mechanism shall impart multiple wedging action against the pipe. Restraining devices shall be of heat-treated ductile iron. Twist-off nuts shall be used to ensure proper actuation of the restraining device.

The mechanical joint retainer gland shall be EBAA Iron, Inc., Series 1100 Megalug, or equal.

3. Ductile iron pipe inside buildings or structures shall be joined with flanged, mechanical joint or mechanical grooved coupling as shown on the Drawings, or as indicated in the pipe schedule.

4. All mechanical joints shall have retainer glands. Flanges shall comply with ANSI 21.15 or AWWA C115 and shall be ANSI 125-pound drilling, unless otherwise specified. Flanged joints shall have full face 1/8-inch rubber gaskets or of thickness and type approved by the Engineer. The pipe shall not be threaded or flanged in the field. Flanges shall be firmly bolted with machine, stud, or tap bolts of the proper size and number. Within buildings the bolts and nuts shall be of the best quality mild steel, with true threads, meeting the requirements of ANSI B16.1.

5. Flange adapters for plain end pipe (not fittings), where specified, shown on Drawings, or approved by Engineer shall be a restrained flange adapter. The restraining mechanism shall be multiple gripping wedges set against the pipe wall. Twist off nuts shall be used to ensure proper actuation of the restraining device. The restrained flange adapter shall be Series 2100 Megaflange by Ebaa Iron, Inc., or equal.

6. Wherever specified or shown, mechanical joints shall conform to ANSI A21.11 (AWWA C111), except as specified under Subsection Process and Pressure Pipe Nuts and Bolts.

7. Couplings, if required or permitted, shall be Dresser Style 38, Rockwell, or equal. Restrained coupling shall be Dresser Style 167 Lock Coupling, Rockwell, or equal.

8. AWWA C219, bolted, split-sleeve type couplings may be used to join AWWA ductile iron pipe up to 48 inches, providing angular deflection and vibration reduction while maintaining the full integrity of the coupling seal. Coupling shall consist of split-sleeve body, closure plates, O-rings (Grade to suit the intended service), sealing pad and bolts and nuts. Couplings shall have fusion bonded epoxy coating or liquid epoxy coating. Victaulic/Depend-O-Lok® ExE flexible couplings or FxE expansion couplings.

9. Ductile iron pipe used at the joint must be minimum Class 53 wall thickness and grooved in accordance with coupling manufacturer recommendations.

10. The gasket shall be pressure-responsive synthetic rubber, FlushSeal design. Victaulic Style 307 transition couplings shall be used to transition from IPS steel pipe to AWWA ductile iron sized pipe. Fittings shall be ductile iron conforming to ASTM A536, Grade 65-45-12, with grooved ends designed to accept mechanical groove-type couplings.

C. Stainless Steel Pipe:

1. Stainless steel pipe less than 4-inch in diameter shall be designed and fabricated in accordance with ASTM A312. The interior surface of the pipe shall be smooth with no protrusions, stiffeners, or bracing. The pipe and fittings shall be constructed of 304L stainless steel, or as specified on the Drawings.

2. Stainless steel pipe shall be minimum Schedule 40S, unless otherwise noted on the Drawings.

3. Fittings shall conform to ASTM A403 and shall have the same wall thickness and structural properties as the pipe. All bends shall be long radius smooth type. Mitered bends will not be acceptable.

4. Flanges where required shall be ASTM A182-F304L flanges with full facing gaskets and centering rings. Flange bolts shall be stainless steel.

5. Wherever possible, butt weld fittings shall be used for field welding. All welds shall be made by a certified welder and shall conform to procedures for which the welder has been certified. The Contractor shall submit certification statements for the welders and the methods employed. Belled end fittings may be used in lieu of butt weld fittings on air lines.

6. All welds shall have full penetration and be smooth and without protrusions on the interior of the pipe. Weld metal shall be equal to or greater than the parent metal. Any cracks or blow holes appearing on the surface of a welding bead shall be ground away before depositing the next bead.

7. All stainless-steel surfaces shall be passivated by the following procedures:

   a. All outside weld areas shall be wire brushed to remove weld splatter. Brushes shall be stainless steel and used only on stainless steel.

   b. All stainless-steel assemblies and parts shall be completely immersed in a pickling solution of 6% nitric acid and 3% hydrofluoric acid at 140 degrees F for a minimum of 15 minutes. Parts shall be free of iron particles or other foreign material after this procedure.

   c. Previously pickled parts shall be neutralized by immersion in a trisodium phosphate rinse.

D. PVC Pipe and fittings shall be composed of Class 12454-B rigid PVC compound in conformance with ASTM D1784 (formerly classified Type I, Grade 1). Pipe shall be Schedule 80 with a design stress of 2000 psi in conformance with ASTM D1785. All joints, unless otherwise shown on the Drawings, shall be solvent welded in conformance with ASTM D2855. Joint solvent shall be as recommended by the pipe manufacturer and shall comply with ASTM D2564. In pressure or vacuum lines and in gravity drains 1-inch diameter and less, the fittings shall be Schedule 80 and shall conform to ASTM D2467. For gravity drains greater than 1-inch diameter, the fittings shall conform to the requirements of ASTM D2665. PVC pipe shall be used for acid-resistant services and all

lines carrying chlorine solution, sodium hypochlorite, De-ionized (DI) water and other chemicals unless otherwise shown on the Drawings or specified.

E. PEX Pipe and Fittings:

1. All pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI 61.

2. Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180°F temperature (690 kPa @ 82°C), and 80 psi gauge pressure at 200°F temperature (550 kPa @ 93°C).

3. Pipe shall be certified by PPI to standard TR-3, with applicable plumbing and mechanical code certifications.

4. Pipe to be manufactured using a high-pressure peroxide method with a minimum degree of crosslinking of 70-89% when tested in accordance with ASTM D2765, Method B.

5. Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023. Pipe to have a minimum extrapolated time-to-failure of 50 years, calculated in accordance with section 13.3 of F2023 and listed as “3006” per the ASTM F876 standard.

6. When required, PEX pipe to have a co-extruded colored UV Shield made from UV-Resistant polyethylene providing UV resistance.

7. Pipe to be manufactured in an ISO 9001 certified production facility.

8. Bend Radius:

   a. The minimum bend radius for cold bending of the pipe shall be not less than 5 times the outside diameter.

   b. Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

9. Pipe to have a Flame Spread Index of less than 25, and a Smoke Developed Index of less than 50 when tested in accordance with ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada). In any case where the pipe does not conform to these standards, appropriate piping insulation shall be installed in order to meet the standard.

10. Fittings:

    a. All Fittings used with crosslinked polyethylene (PEX) water distribution pipe intended for plumbing applications shall be of the cold-expansion compression-sleeve design.

    b. All Fittings shall be third-party certified to applicable standards ASTM F877, ASTM F2080, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5 and

approved by the manufacturer's PEX piping system, with applicable plumbing and mechanical code certifications.

c. Compression-sleeve fittings shall be manufactured of brass and shall be supplied by the piping manufacturer as part of a proven cataloged system.

d. Where fittings are encased in concrete or buried underground, fittings shall be wrapped as per manufacturer's recommendation to protect the material.

F. Polyethylene Pipe with heat fusion joints and compression type metal fittings shall be used for underground natural gas service lines and chemical service lines.

1. Piping shall comply with ASTM D2513, ANSI B31.8, and AGA standards.

2. Fittings shall be approved plastic for making heat fusion joints complying with ASTM D2513, D2683, D3197, D3261, D3350. When applicable, compression fittings shall be Dresser 401 plastic.

3. Outside risers shall be flexible steel casing or rigid noncorrosive steel encased plastic and shall be coated and cathodically protected.

4. All underground pipe shall be traced with No. 12 insulated wire taped and installed as required by the governing authority.

5. Polyethylene Pipe shall be SDR 11 with a working pressure of 100 psi and shall be Phillips Driscopipe 8000, or equal.

2.02 VALVES

A. Unless otherwise specified or shown on drawings, valves installed in pipelines 3-1/2-inch diameter and smaller for process water lines shall be gate valves; for compressed air and vacuum, globe valves; for natural and sewage gas lines, lubricated plug or eccentric nonlubricated plug valves; and for gas lines less than 2-inch diameter tapered nonlubricated plug cocks; for fuel oil, ball valves; for sludge, eccentric nonlubricated plug valves. Valves for other types of services when required will be specified under that Section.

B. Gate Valves shall be 150-pound, all bronze, rising stem, solid wedge disc furnished with screwed or flanged ends as required. Gate valves shall be Crane No. 431, Jenkins No. 47-U, Powell No. 514/515, or equal.

C. Ball Valves through 2-inch shall be screwed end bronze, two-piece, 125 psi, Teflon seats, bronze trim, and blowout-proof stem, Nibco No. T-580-BR-Y-20, or equal.

D. Butterfly Valves shall be AWWA, Class 150 B, wafer body equipped for ANSI 125-pound flanges. Butterfly valves shall provide bubble-tight shutoff to 150 psig cold water pressure. The valve body shall be made from ASTM A126, Grade B cast iron or equal. The valve disc shall be made with nickel-coated cast iron, bronze, or equal. Valve shall

have bronze shaft bearings, O-ring shaft seals, and EPDM valve body seat Keystone Figure 239, or equal. Valves shall be hand lever actuated.

E. Check Valves shall be 200-pound, all bronze body with bronze disc, Y-pattern, with flanged or screwed ends as required. The check valves shall be Crane No. 36, Powell 560-Y/561-Y, Jenkins 762-A, or equal. Non-slam check valves shall be used on all pipelines operating at 25 psig or higher pressure and shall be Valve and Primer Corporation, Series 300 or equal.

F. Nonlubricated Plug Valves shall be 150-pound, all bronze body and plug, with synthetic rubber faced plugs and have screwed or flanged ends as required. They shall be DeZurik Figure 120, or equal. Valves shall operate with nonremovable lever type handles.

G. Sampling Cocks shall be Ernest Gage Co. Fig. 29, Conbeaco, or equal.

2.03 PVC VALVES

A. PVC Ball Valves shall be used in all PVC lines under this Section. Ball valves shall be PVC body, Nibco Chemtrol True Union Ball Valve, TU or DE; Corro-Flo; or equal.

B. PVC Butterfly Valves:

1. Butterfly Valves shall be made of Class 23447-B rigid PVC compound in conformance with ASTM D1/84 (formerly classified Type IV, Grade 1).

2. Shaft shall be 316 stainless steel. Seats and secondary seals shall be Viton.

3. Bearings shall be glass filled Teflon. Butterfly valves shall have a pressure rating of 150 psi at 70 degrees F.

4. Valve bodies shall be the wafer type compatible with 150-pound ANSI flanges.

5. Valves which are scheduled to be motor operated shall be furnished with mounting saddle. Manually operated valves shall be furnished with lever operators.

C. Check Valves:

1. Check Valves shall be made of Class 12454-B rigid PVC compound in conformance with ASTM D1784 (formerly classified Type I, Grade 1).

2. All check valves shall have Viton seals.

3. Check valves 4-inch size and smaller shall be true union ball checks.

D. PVC Pressure Relief Valves shall be Wallace & Tiernan No. U-23655, Fischer & Porter, or equal, with 1-inch female NPT BPV connections. These shall not be used on chlorination systems.

2.04 RESERVED

2.05 RESERVED

2.06 HOSE BIBBS

A. Hose bibbs inside buildings shall be all bronze angle hose valves with 3/4 by 11-1/2 threads per inch American (National) or Chicago Standard Hose Threads, Mueller Brass Co. No. V-1016, or equal. Hose bibbs shall have nonremovable type vacuum breaker, Watts No. 8A, or equal. Hose bibbs shall be located 3-feet above the floor.

2.07 SILL COCKS

A. Sill cocks shall be cast bronze non-freeze wall hydrants, Wade W-8620, Zurn Z-1310, or equal, with 3/4 by 11-1/2 threads per inch hose connection, polished face, galvanized wall sleeve, renewable seat, brass or bronze operating parts, ground joint union elbow adapter with 3/4-inch IPS (or 3/4-inch solder) and removable T-handle.

2.08 ELECTRIC VALVE OPERATORS (OPEN-CLOSE)

A. Electric operators shall be sized and geared to meet the torques required at a valve opening and closing speed of 2 to 8 seconds per 90-degree rotation. The operator shall be rated for 25% duty cycle at maximum rate output.

B. Operators shall be powered by 115 v, single phase, 60 Hz current and shall operate in any mounting attitude.

C. Operators shall have thermal overload protection, reversing magnetic starter, and a NEMA 4 enclosure for all electrical components. The starter shall be capable of receiving contact closures from remote sources to actuate the operator in either direction. The operating motor shall be provided with surge suppression to limit voltage transients. The surge suppression device shall be equal to Electrocube Part No. RC1782, sized as required to suit the motor characteristics.

D. Adjustable limit switches shall be provided. Two limit switches shall be used for de-energizing operator once the fully open position or fully closed position of the valve is reached. Two limit switches shall be used for remote indication of end positions. Limit switches shall be single pole double throw snap acting totally enclosed and rated at 250 VAC.

E. Each operator shall be equipped with a manual override feature with manual lockout switch to prevent electrical operation when in the manual mode. Upon completion of manual operation, the operator will automatically return to the electrical mode.

F. Each operator shall be supplied with local indicator for visual valve position and an electro-mechanical brake to minimize overrun.

G. Electric motor valve operators that are to be supplied with butterfly valves shall be sized for 1-1/2 times the valves rated torque or a minimum of 400-inch-pound, whichever is greater.

H. The operators shall be a product of Raymond Control Systems, Worcester Control, or equal. Operators shall have easily identifiable terminal blocks for all external power and control connections.

2.09 STRAINERS

A. Strainers shall be provided where shown on the Drawings and as required to meet local and State codes. Strainers shall also be provided in all water lines ahead of all solenoid valves, pressure regulators, and pilot valves.

B. Unless otherwise specified or required by code, strainers shall be Leslie Model 7000, Mueller Muessco Model 11, or equal. Strainer shall have a Y-pattern cast iron body and a 40-mesh stainless steel screen.

C. The Contractor shall provide a plug cock for blow-off purposes.

2.10 RESERVED

2.11 SLEEVES

A. Type B Sleeve:

1. Type B sleeves are for use in exterior walls.

2. Type B sleeves consist of casting in place a black wrought iron sleeve two sizes larger than the service pipe with couplings on both ends of the sleeve.

3. Service pipe shall be caulked in place with oakum. The oakum shall be covered with a minimum of 1-inch of lead wool on both ends.

B. Type C Sleeve:

1. Type C sleeves are used in exterior walls.

2. Type C shall be a modular mechanical type seal of interlocking synthetic rubber links by Link-Seal, or equal.

3. Unless otherwise indicated, the seal shall be suitable for corrosive service in a temperature range of minus 40 degrees F to 250 degrees F. The pressure plates shall be of Delrin plastic for good resistance to organic compounds. The bolts and nuts shall be of 18-8 stainless steel. The sealing elements shall be of EPDM rubber which has high resistance to most organic and inorganic materials.

C. Type D Floor Sleeve - Type D sleeves consist of casting in place a steel sleeve with four anchors in the floor slab. The sleeve shall be one size larger than the service pipe or 1-inch larger than the flange on the service pipe. The sleeve shall extend 1-inch above the finish floor surface.

2.12 RESERVED

2.13 RESERVED

2.14 RESERVED

PART 3 EXECUTION

3.01 INSTALLATION

A. Cutting of all pipe shall be done with sharp tools. The ends of each pipe shall be reamed until all burrs or fins are removed. Full tapered threads shall be used throughout and threaded joints shall turn up perfectly tight without the use of filling substances. A standard pipe joint paste or tape suitable to use of pipe shall be used on the male threads only, and none shall be allowed to accumulate on the inside of the pipes. All connections between pipe, pipe hangers, and equipment shall be made with an approved dielectric insulating material. Dielectric unions or insulated couplings shall be installed between any dissimilar metallic piping materials or at connections between dissimilar metallic pipes and equipment, tanks, etc.

B. Pipe joints shall conform to respective industry standards.

C. Expansion and contraction of the piping system shall be provided for by the use of swing joints, right angle loops, or approved expansion joints. Branch connections shall have three elbow spring pieces to allow for movement. Unless specified in Part 4, the piping system shall provide for the expansion as required in Section 15010. An expansion joint is also required at all building isolation or expansion joints.

D. Interior and exterior pipelines shall be installed and graded in accordance with State and/or Local Codes. Interior pipes shall run at right angles or parallel to building walls, placed as close as practicable to the ceiling and/or walls, and supported according to Section 15010. Drain valves shall be installed at all low points.

E. Pipe groups shall be run parallel with pipes of other trades, and wherever practicable, all piping shall be supported on common group hangers unless pitch of pipe as hereinbefore mentioned is required.

F. The piping shall be installed in a workmanlike manner and shall avoid interference with columns, beams, equipment, and other piping or fixed construction. A minimum of 7-feet of headroom shall be maintained at any point including stairs.

G. Type C wall sleeves shall be provided for all pipes passing through exterior walls unless other sleeve types are noted on the Drawings. Type C sleeves shall also be provided in interior walls where indicated on the Drawings, Type D floor sleeves shall be used where piping passes through floor. Other sleeve types shall be used where shown on the Drawings.

H. Buried pipe shall be firmly bedded the full length with the exception where bell holes are required. Buried piping located less than 3-feet below a building slab or footing shall be encased in concrete. Where unstable soil conditions occur under buildings, support

shall be made from the underside of the structural slab by an approved type hanging device embedded in the concrete.

I. Unless shown otherwise on the Drawings, all buried pipe carrying liquids shall be installed with a minimum cover of 42-inch. Pressure piping which carries gases shall be installed with a minimum cover of 3-feet. When new piping crosses existing utilities and other obstructions which force a change in elevation or horizontal alignment, the Contractor shall install the new piping at a deeper elevation or new alignment to avoid the obstructions unless otherwise instructed by the Engineer. Such changes in elevation or alignment shall be made either by installing fittings or by deflecting joints in accordance with the pipe manufacturer's recommendations. Such Work shall be performed at no additional cost to the Owner. To the extent possible, pressure and process piping shall be installed at a constant grade. All changes in grade shall be approved by the Engineer.

J. Where PVC piping is laid in a trench, the bottom of the trench shall be well graded and compacted to insure even bearing for the full length of the pipe and the pipe shall be snaked at approximate 50-foot intervals to provide for expansion or contraction. Prior to testing the pipe, the pipe shall be center loaded with backfill between joints before testing to prevent the pipe from arching or whipping under pressure. During backfill the line shall be pressurized to 25 psi to minimize impact damage.

K. All valves shall be installed with their stems horizontal or above. As far as possible, all valves of the same type shall be of the same manufacturer.

L. The T-drill method manufacturing tees in continuous copper tubing is not acceptable.

3.02 EQUIPMENT CONNECTIONS

A. The Contractor shall make all connections where required between the various piping systems and all pieces of equipment. This shall include adapters, traps, backwater valves, or other fittings required when not furnished with the equipment.

B. Unions - Provide a union or flange in piping connections to each valve, device, or item of equipment, and elsewhere as required to makeup or disconnect piping. Each union shall be so installed as to permit the removal of parts and equipment for inspection and cleaning, and shall be installed in a position which will permit the valve device or part to be removed without disconnection of any piping except unions. Union and flange shall be installed in such a position as will be accessible for disconnection items which are to be screwed. All ground joint unions on copper lines shall be cast brass or bronze. Wrought copper unions are not to be used. All unions, where possible, shall be brass to MPT type.

3.03 INSTRUMENTATION CONNECTIONS

A. The Contractor shall make all necessary allowances for and install all controls and instrumentation furnished under any Contract Division and which require in-line connection to process and pressure piping.

B. The Contractor shall provide all necessary mounting bosses, pipe and boss taps, plugs, tees, and any miscellaneous appurtenances to allow connection of Instrumentation and Controls and their associated piping to process and pressure piping.

C. Instrumentation and Controls are furnished and specified under various Sections including Section 16902. Any schedules shown in Section 16902 are not guaranteed to be complete.

3.04 RESERVED

3.05 PRESSURE TESTING FOR (GAS) PROCESS AND PRESSURE PIPE

A. All new and reused pipelines conducting gases shall be tested for tightness by the Contractor before final approval. All testing shall be witnessed by the Resident Engineer. Testing of natural gas lines shall meet the requirements of this Section or the governing authority.

B. All gas conducting pipelines shall be tested at 100 psig or 150% of the normal operating pressure, whichever is greater.

C. The test medium shall be air or an inert gas such as nitrogen or carbon dioxide. Oxygen, water, and/or natural gas are not to be used. Testing for leaks shall be done with an approved leak detector, or by brushing a soap solution or equivalent on each joint while the system is under pressure.

D. The Contractor shall provide for proper purging of all natural gas piping. All such purging shall be scheduled to minimize interruptions to the continued use of existing natural gas pipelines. After the piping has been pressure tested, leak tested, and approved, it shall be fully purged or cleared of air at the most distant point from the point of entry of the gas. This involves replacement of the atmosphere within the natural gas conduit by an inert substance in such a manner as to prevent the formation of explosive mixtures. Each major branch line shall be similarly purged at its far end. Purging shall be done only by personnel experienced in this particular operation.

3.06 DISINFECTION OF WATER MAINS

A. After the pressure test and prior to disinfecting, the lines shall be thoroughly flushed through hydrant fixtures or by other means as approved by the Engineer.

B. The Contractor shall furnish required materials and apparatus and perform the Work of disinfection. Temporary and permanent materials, apparatus and appurtenances shall have the same NSF 61 approval and the installed work.

C. All water lines shall be cleaned and disinfected in accordance with federal, state and local codes; and AWWA C651, generally outline as follows.

1. Liquid sodium hypochlorite applied means of a suitable solution feed machine or pump. Sodium hypochlorite storage conditions and durations shall be controlled to minimize deterioration.

2. Calcium hypochlorite applied tablets, powder. Tablets or powder shall be placed in the water line during construction. The water line shall be filled, carefully, with potable water to produce a uniform solution.

3. Calcium hypochlorite applied as a water mixture. The calcium hypochlorite powder shall be mixed with water to form a paste and then thinned to a slurry, to be introduced into the pipe by pumping.

D. The dosage of chlorinating agent shall be of the amount to produce a minimum chlorine residual of 50 parts of chlorine per million. Tests with the DPD drop dilution method shall be made at selected points to determine the residual.

E. Treated water shall be retained in the lines for sufficient time to accomplish the desired disinfection but not less than 24 hours. Valves in the line shall be operated during the retention period.

F. Following disinfection, all treated water shall be flushed from the lines at their extremities until the replacement water throughout the lines shall, upon testing, be chemically and bacteriologically acceptable.

1. Two or more successive sets of samples taken at 24-hour intervals shall indicate microbiologically satisfactory water before the lines are placed into service.

2. Should the initial treatment prove ineffective, the disinfection shall be repeated until the test shows acceptable results.

G. All testing shall be done by a laboratory acceptable to the public authority having jurisdiction, and all costs shall be paid for by the Contractor.

3.07 EQUIPMENT DRAINS

A. Seal chamber, base plate drains, and equipment drains shall be piped to the nearest floor or equipment drain with copper lines as directed by the Engineer. All discharges shall provide a 2-inch minimum air gap above the drain.

PART 4 SPECIAL PROVISIONS

4.01 WATER HOSES AND ACCESSORIES

A. Water hoses shall be general purpose industrial grade with radial belted reinforcement of synthetic yarns. Tube and cover material shall be black EPDM. The hose shall have a minimum water pressure rating of 150 psi. End fittings shall be heavy duty 3/4 by 11-1/2 threads per inch American (National) or Chicago Standard Hose Threads.

B. 3/4-inch diameter and 50-feet long hoses shall be furnished. A threaded brass hand operated control nozzle shall be provided for each hose.

C. Hose racks shall be provided and mounted at the locations as designated by the Engineer. Each rack shall have a minimum capacity of 100-feet of 3/4-inch hose. Racks shall be heavy duty steel construction. Provide one rack per hose. Racks shall be a Dura-Loop Utility Caddy by TFC, Inc. or equal.

4.02 POLYETHYLENE PRESSURE TUBING

A. Polyethylene pressure tubing shall be furnished and installed in the Plant Effluent Sampling Station as shown on the Drawings.

B. Tubing shall meet the requirements of ASTM D2737 and AWWA C901, latest revisions.

C. Specifications of and marking on the tubing shall be the following with markings spaced at intervals of not more than 5-feet:

1. Plastic tubing type: PE2305.
2. Pressure rating for water at 73-degree F: 160 psig.
3. Designation: ASTM D2737 or AWWA C901, with which the tubing complies.
4. Manufacturer's name (or trademark).
5. Testing agency seal.

4.03 PIPING SERVICE MATERIAL REQUIREMENTS

A. The following are the material classifications to be used for the piping service identified.

Service	Piping	Gaskets
Plant Water in Buildings	PE or PEX	
Plant Water Buried	Ductile Iron (DIP)	
Irrigation Lines Buried and in Buildings	Schedule 80 PVC	
Sump Pump Buried and in Buildings	Schedule 80 PVC	

4.04 SPARE PARTS

A. The Contractor shall furnish enough valve washers and strainers to replace all the originals on the project one time and include one set of wrenches required to do the Work.

4.05 MISCELLANEOUS PRODUCTS

A. Shock Absorbers - Zurn "Shoktrol" Josam, or equal. Unit shall conform with ASSE 1010.

B. Relief Valves - All brass, Crane No. 2606, Kennedy, or equal, unless noted; pipe to floor.

4.06 PRESSURE GAUGES

A. Pressure gauges and thermometers shall be 4-1/2-inch in size with fiberglass reinforced polypropylene case, phosphor bronze bourdon tube, 6-inch or 4-1/2-inch dial faces with

black lettering, micrometer type pointers and an accuracy of 1% of scale range. Pressure gauge shall be H.O. Trerice No. 450 series, Ashcroft 2462 series, or equal.

B. Pressure gauges shall read in pressure or compound as required by use.

C. All pressure gauges unless otherwise directed shall include a brass pressure snubber and a needle type shut-off valve.

D. Where directed, pressure gauges shall have diaphragm seals. The gauges, seals, and snubber shall be factory assembled and filled with a stainless-steel housing. Diaphragm seal shall be an Ashcroft 101 series, H.O. Trerice 877-2 series, or equal.

E. Thermometers shall be of the mercury in glass type with 9-inch C scale of proper range for the service shown and an adjustable angel mount. The thermometer shall be an H.O. Trerice BX9, US Gauge, or equal.

F. Pressure gauges shall be installed at each chorine ejector installation and elsewhere as shown on the Drawings and specified under other Sections.

4.07 EXPANSION JOINTS

A. For pipe sizes 1/2-inch to 3/4-inch use an Arch Type, Holz Rubber Co., Model 300 or equal.

B. Joints shall be single arch type with control rods and plates. Joints shall have a one-piece elastomer leak free tube compatible with the process fluid. The manufacturer shall select the tube material.

C. For pipe sizes 2-inch up to 4-inch use a Mercer style 500 or equal. Joints shall be a single arch type with control rods and plates. Joints shall have a one-piece elastomer leak free tube compatible with the process fluid. The manufacturer shall select the tube material.

4.08 INSULATION FOR PIPES

A. Pipe insulation shall be as specified in Section 15504.

4.09 WALL HYDRANT

A. Wall hydrants shall be 3/4-inch hose connection, polished face, galvanized wall sleeve, renewable seat, nonremovable type vacuum breaker, brass, or bronze operating parts, ground joint union elbow adapter with 3/4-inch IPS (or 3/4-inch solder) and removable T-handle.

4.10 TRACING WIRE

A. Tracing Wire shall be installed on all buried non-conductive pipe.

1. Wire shall be Direct Burial No. 12 AWG Solid (0.0808-inch diameter), with 45 mil, high molecular weight, high density polyethylene jacket complying with ASTM D1248, 30 volt rating. Wire shall be SoloShot™ extra high strength No.

1245 as manufactured by Copperhead Industries, LLC, or equal. Wire shall be secured to the pipe with tape at intervals not to exceed 10 feet.

a. Tracer wire installed on pipe by horizontal directional drilling shall be continuous without any splices.

b. Heat shrink splices are permissible only on tracer wire at pipe connection.

2. Tracing wires shall terminate inside all structures including but not limited to, air relief structures, valve box assemblies, indicated on plans. Tracer wire shall extend 4-feet above the opening on structures.

B. Tracing wire shall be tested for continuity after installation and considered acceptable when a continuous read is obtained between terminals.

END OF SECTION

SECTION 15410
PLUMBING PIPING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all necessary plumbing piping, components, connecting piping, and accessories, and a complete plumbing system for each service or combination of services.

B. Each system shall be adequate to conduct and control the flow of hot and cold potable water, sanitary lines, vents, roof drains, or other uses as specified or shown on the Drawings.

C. Plumbing is defined to include all potable water and all building sanitary drainage and vents and all building storm drainage of every size located in all buildings and up to a point, 5-feet -0-inch outside each building.

D. Work includes, but is not limited to:

1. Securing and bearing the cost of all permits, certificates, and inspection as required by local regulations and state plumbing codes.

2. All pipe, fittings, and connections to sanitary fixtures for potable water supply and waste, including vents, roof drains, floor drains, equipment drains, traps, cleanouts, and backwater valves.

3. Pressure gauges, thermometers, control devices, pipe hangers, anchors, supports, hose bibbs, sill cocks, and sleeves.

4. Potable water supply to boiler makeup water stop valves, or other equipment requiring these services.

5. Pipe insulation complete with jacket as required by Section 15504.

6. Sanitary fixtures, sinks, lavatories, backflow preventer valves, water coolers, acid neutralizing basins, oil and grease separators, and water heaters.

E. Additional product requirements are specified in Section 01350.

F. All equipment, materials, and Work shall comply with Federal, State, and local plumbing codes. Equipment materials and Work specifically required by Federal, State, or local plumbing codes whether or not shown on the Drawings or specified shall be provided by the Contractor at no change in Contract Price.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. Manufacturer's literature.
2. Information for the Record:
    a. Material certificates.
    b. Licenses and permits.
    c. Operation and maintenance manual.

1.03 CONTRACT DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping.

B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

1.04 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.
2. All valves, toilet fixtures, and appurtenances shall be crated before shipment.
3. All plastic fixtures and pipe, if stored outside, shall be covered with an opaque material to protect them from the sun's rays.

B. After Installation:

1. Suitable covers and guardrails shall be placed to protect against chipping enamel or denting the surfaces of any equipment after it is installed and during the final days of construction.
2. Before acceptance, all covers and protective material shall be removed and the fixtures and equipment cleaned and ready for use.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Cast Iron Soil Pipe within and below building shall conform to ASTM A74 and CSPI-301. Joints shall be lead and Oakum or Elastomeric gaskets ASTM C564.

1. Place concrete thrust blocks at all below grades turns and below grade off-sets for waste and storm piping 4-inch and larger.

2. No-hub pipe and fittings may be used where approved by the State and local authority and where no portion of the piping, including the highest vent joint, could be subject to pressure potential of over 10-feet of head (4.3 psig). The pipe and fittings shall conform to CISPI-301. The couplings shall conform to FM Standard 1680, Class I and rated for 15 psig working pressure as furnished by Clamp-All, Haverhill, MA.

B. Ductile Iron Pressure Pipe (DIP):

1. Ductile Iron Pressure Pipe (DIP) shall conform to ANSI A21.51 or AWWA C151 and shall be pressure class 350 psi for sizes 12-inch and below, and pressure class 300 psi for larger sizes unless otherwise specified herein. Mechanical joint fittings shall be ductile iron and conform to ANSI A21.10 or AWWA C110 and ANSI A21.53 or AWWA C153. Flanged fittings shall be ductile iron and conform to ANSI A21.15 or AWWA C115. All fittings shall have a pressure rating of 250 psi for all pipe sizes unless otherwise specified.

2. Ductile iron pipe buried underground, unless otherwise specified or shown, shall have rubber gasket (slip-on) type joints in straight runs and mechanical joints with retainer glands each way from bends as shown on the Drawings. The gasket shall be a single molded rubber ring fitted into a specially shaped recess in the bell forming a pressure tight seal. The spigot end of each pipe shall be marked to indicate when the pipe is “home.” Fittings shall have mechanical joints with retainer glands unless otherwise specified or shown. Retainer glands shall be ductile iron. The restraining mechanism shall impart multiple wedging action against the pipe. Restraining devices shall be of heat-treated ductile iron. Twist-off nuts shall be used to ensure proper actuation of the restraining device. The mechanical joint retainer gland shall be EBAA Iron, Inc., Series 1100 Megalug, or equal.

3. Ductile iron pipe inside buildings or structures shall be joined with flanged, mechanical joint or mechanical grooved coupling as shown on the Drawings, or as indicated in the pipe schedule.

4. All mechanical joints shall have retainer glands. Flanges shall comply with ANSI 21.15 or AWWA C115 and shall be ANSI 125-pound drilling, unless otherwise specified. Flanged joints shall have full face 1/8-inch rubber gaskets or of thickness and type approved by the Engineer. The pipe shall not be threaded or flanged in the field. Flanges shall be firmly bolted with machine, stud, or tap bolts of the proper size and number. Within buildings the bolts and nuts shall be of the best quality mild steel, with true threads, meeting the requirements of ANSI B16.1.

5. Flange adapters for plain end pipe (not fittings), where specified, shown on Drawings, or approved by Engineer shall be a restrained flange adapter. The

restraining mechanism shall be multiple gripping wedges set against the pipe wall. Twist off nuts shall be used to ensure proper actuation of the restraining device. The restrained flange adapter shall be Series 2100 Megaflange by Ebaa Iron, Inc., or equal.

6. Wherever specified or shown, mechanical joints shall conform to ANSI A21.11 (AWWA C111), except as specified under Subsection Process and Pressure Pipe Nuts and Bolts.

7. Couplings, if required or permitted, shall be Dresser Style 38, Rockwell, or equal. Restrained coupling shall be Dresser Style 167 Lock Coupling, Rockwell, or equal.

8. AWWA C219, bolted, split-sleeve type couplings may be used to join AWWA ductile iron pipe up to 48 inches, providing angular deflection and vibration reduction while maintaining the full integrity of the coupling seal. Coupling shall consist of split-sleeve body, closure plates, O-rings (Grade to suit the intended service), sealing pad and bolts and nuts. Couplings shall have fusion bonded epoxy coating or liquid epoxy coating. Victaulic/Depend-O-Lok® ExE flexible couplings or FxE expansion couplings

9. Ductile iron pipe used at the joint must be minimum Class 53 wall thickness and grooved in accordance with coupling manufacturer recommendations.

10. The gasket shall be pressure-responsive synthetic rubber, FlushSeal design. Victaulic Style 307 transition couplings shall be used to transition from IPS steel pipe to AWWA ductile iron sized pipe. Fittings shall be ductile iron conforming to ASTM A536, Grade 65-45-12, with grooved ends designed to accept mechanical groove-type couplings.

C. Polypropylene Pipe - The polypropylene homopolymer used in the manufacturing of flame retardant piping components shall be cell classification PP110-B66362 as described in ASTM D4101. Flame retardant polypropylene materials are classified as self-extinguishing by ASTM D635, UL - 94 and Federal Aviation Regulation FAR 25.853. Test results, conforming to ASTM E84 and UL 723 procedures for flame spread and smoke density, resulted in a flame spread value of 12 or less, with a smoke density rating of 85 of less. Joints shall be electronically fused. Chemtrol Chem-fuse or Equal.

1. Pipe shall be iron pipe size (IPS) type in 10 - foot lengths with dimensions conforming to the requirements of ASTM D1785 for Schedule 40 pipe. Fitting patterns shall conform to ASTM standard D-3311 for drain, waste and vent (DWV) configurations. Pipe and fitting dimensions shall be measured in accordance with ASTM D2122. Pipe and fittings shall be tan and marked with nominal size. All materials shall be made in the USA.

2. Fusion coils shall be constructed from No. 29 AWG copper magnet wire. Coil wire shall have a polypropylene coating with no gaps.

D. PEX Pipe

1. All pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI 61.

2. Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180°F temperature (690 kPa @ 82°C), and 80 psi gauge pressure at 200°F temperature (550 kPa @ 93°C).

3. Pipe shall be certified by PPI to standard TR-3, with applicable plumbing and mechanical code certifications.

4. Pipe to be manufactured using a high-pressure peroxide method with a minimum degree of crosslinking of 70-89% when tested in accordance with ASTM D2765, Method B.

5. Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023. Pipe to have a minimum extrapolated time-to-failure of 50 years, calculated in accordance with section 13.3 of F2023 and listed as “3006” per the ASTM F876 standard.

6. When required, PEX pipe to have a co-extruded colored UV Shield made from UV-Resistant polyethylene providing UV resistance.

7. Pipe to be manufactured in an ISO 9001 certified production facility.

8. Bend Radius:

   a. The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter.

   b. Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

9. Pipe to have a Flame Spread Index of less than 25, and a Smoke Developed Index of less than 50 when tested in accordance with ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada). In any case where the pipe does not conform to these standards, appropriate piping insulation shall be installed in order to meet the standard.

10. Fittings:

    a. All Fittings used with crosslinked polyethylene (PEX) water distribution pipe intended for plumbing applications shall be of the cold-expansion compression-sleeve design.

    b. All Fittings shall be third-party certified to applicable standards ASTM F877, ASTM F2080, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5 and approved by the manufacturer’s PEX piping system, with applicable plumbing and mechanical code certifications.

2.02 VALVES

A. Unless otherwise specified, valves installed in pipelines 3-1/2-inch diameter and smaller for potable water lines shall be gate valves.

B. Gate valves shall be 150 pounds, all bronze, rising stem, solid wedge disc furnished with screwed or flanged ends as required. Gate valves shall be Crane No. 431, Jenkins No. 47, Powell No. 514, or equal.

C. Check valves shall be 200 pounds, all bronze body with bronze disc, y-pattern, with flanged or screwed ends as required. The check valves shall be Crane No. 36, Powell 560-Y, Jenkins 762-A, or equal. Non-slam check valve shall be used on all pipelines with 25 psi or more pressure and shall be Valve and Primer Corporation, Series 300 or equal.

D. Ball valves through 2-inch shall be screwed end bronze, two-piece, 125 psi, Teflon seats, bronze trim, and blowout-proof stem, Nibco T-580-BR-Y-20 or equal.

2.03 SLEEVES

A. Type B Sleeve:

1. Type B sleeves are for use in exterior walls.

2. Type B sleeves consist of casting in place a black wrought iron sleeve two sizes larger than the service pipe with couplings on both ends of the sleeve.

3. Service pipe shall be caulked in place with oakum. The oakum shall be covered with a minimum of 1-inch of lead wool on both ends.

B. Type C Sleeve:

1. Type C sleeves are used in exterior walls and other walls as designated on the Drawings.

2. Type C shall be a modular mechanical type seal of interlocking synthetic rubber links.

3. Unless otherwise indicated, the seal shall be suitable for corrosive service in a temperature range of 40-degree F to 250-degree F. The pressure plates shall be of Delrin plastic for good resistance to organic compounds. The bolts and nuts shall be of 18-8 stainless steel. The sealing elements shall be of EPDM rubber which has high resistance to most organic and inorganic materials.

C. Type D Floor Sleeve - Type D sleeves consist of casting in place a Schedule 40 steel sleeve with four anchors in the floor slab. The sleeve shall be one size larger than the service pipe or 1-inch larger than the flange on the service pipe. The sleeve shall extend 1-inch above the finish floor surface.

D. Type E Sleeve:

1. Type E wall sleeves shall be used where noted on the Drawings.

2. Type E sleeves consist of casting in place mechanical joint, cast iron wall sleeves meeting the requirements of AWWA C110 and C111.

3. Each Type E sleeve shall be sealed using plain rubber gaskets, follower glands, and mechanical joint studs meeting all requirements of AWWA C111 on both ends.

2.04 RESERVED

2.05 EXTRA STOCK

A. Furnish enough valve washers and strainers to replace all the originals on the project one time and include one set of wrenches required to do the Work.

PART 3 EXECUTION

3.01 INSTALLATION

A. Cutting of all pipe shall be done with sharp tools. The ends of each pipe shall be reamed until all burrs or fins are removed. Full tapered threads shall be used throughout and threaded joints shall turn up perfectly tight without the use of filling substances. A standard pipe joint paste shall be used on the male threads only, and none shall be allowed to accumulate on the inside of the pipes. All connections between pipe, pipe hangers, and equipment shall be made with an approved dielectric insulating material.

B. Pipe joints shall conform to respective industry standards.

C. Expansion and contraction of the piping system shall be provided for by the use of swing joints, right angle loops, or approved expansion joints.

D. Interior and exterior pipelines shall be installed and graded in accordance with State and/or Local Plumbing Codes. Interior pipes shall run at right angles or parallel to building walls, placed as close as practicable to the ceiling and/or walls, and supported by hangers or brackets. All hangers and inserts or other approved method of pipe supports shall be provided. The inserts or anchor bolts shall be located according to Drawings and Specifications and installed in the concrete at the time it is placed.

E. Drain valves shall be installed at all low points. Vent valves shall be installed at all high points.

F. Pipe groups for plumbing shall be run parallel with pipes of other trades, and wherever practicable, all piping shall be supported on common group hangers unless pitch of pipe as hereinbefore mentioned is required.

G. The piping shall be installed in a workmanlike manner and shall avoid interference with columns, beams, equipment, and other piping or fixed construction. A minimum of 7-feet of headroom shall be maintained at any point including stairs.

H. Type C wall sleeves shall be provided for all pipes passing through exterior walls unless other sleeve types are noted on the Drawings. Type C sleeves shall also be provided in interior walls where indicated on the Drawings, Type D floor sleeves shall be used where piping passes through floor. Other sleeve types shall be used where shown on the Drawings.

I. Provide a system of vents from each plumbing fixture and drain, extended to drain at the bottom, and through the roof, providing equalized pressure on every trap. As a minimum the system shall be as indicated on the Drawings, but in no case, shall the complete system be less than required by the State and local Plumbing Codes.

J. Sanitary waste and vent piping indicated may, in some instances, exceed the code requirements. If Drawings indicate individual wastes for each fixture, then the Drawings and Specifications shall hold precedence over the code even though it exceeds the prescribed waste and vent code minimum.

K. Each vent stack shall be carried through the roof whether in combination with its parallel soil stack or in multiple combination with other vent stacks. Each vent or stack shall be increased one pipe size before passing through roof, but in no case, shall a vent through the roof be less than 4-inch

L. All vents through the roof less than 18-inch from an outside wall shall be offset by means of 1/4 bends to permit proper flashing.

M. Stacks enclosed in wall chases in finished rooms shall have extension pieces placed in tees set to bring the cleanout plugs just back of the finished wall line, and finished at the wall line with chromium plated cleanouts, Zurn No. 1440-1, Josam, or equal.

N. Buried pipe shall be firmly bedded the full length with the exception where bell holes are required. Unless shown otherwise on the Drawings, all pipelines shall be installed with a minimum cover of 5-feet. Where unstable soil conditions occur under buildings, support shall be made from the underside of the structural slab by an approved type hanging device embedded in the concrete.

O. Unless shown otherwise on the Drawings, all buried pipe carrying liquids shall be installed with a minimum cover of 5-feet. Pressure piping which carries gases shall be installed with a minimum cover of 4-feet. When new piping crosses existing utilities and other obstructions which force a change in elevation, the Contractor shall install the new piping at a deeper elevation to avoid the obstructions unless otherwise instructed by the Engineer. Such changes in elevation shall be made either by installing fittings or by deflecting joints in accordance with the pipe manufacturer’s recommendations. Such Work shall be performed at no additional cost to the Owner. To the extent possible, pressure and process piping shall be installed at a constant grade. All changes in grade shall be approved by the Engineer.

P. Extend downspout laterals from each roof drain and riser to storm drainage system. Make direction changes with TY fittings or Y fittings and 1/8 bends as required. Install cleanouts at each direction change, and the base of each riser, and at 50-foot intervals in horizontal straight runs.

Q. Horizontal piping shall be suspended to a grade of not less than 1/8-inch per-feet wherever possible, and as close to construction as practicable to insure maintenance of schedule ceiling heights and avoid interferences. Direction changes, junctions, etc., shall be made with TY fittings or Y fittings and 1/8 bends as required. Provide cleanouts at all directions, changes, dead ends, and at 50-foot intervals on straight runs.

R. Install cleanout fittings at the base of each vertical pipe used for sanitary drains, roof conductors, or vent stacks, and at each change of direction of the building drain greater than 45 degrees F.

S. The ends of all horizontal drain lines shall be extended to cleanouts as specified above with top of plug set level with the finished floor.

T. Underground traps, except “P” traps, into which floor drains with removable strainers discharge, shall be provided with accessible and removable cleanouts.

U. Where PVC piping is laid in a trench, the bottom of the trench shall be well graded and compacted to insure even bearing for the full length of the pipe and the pipe shall be snaked at approximate 50-foot intervals to provide for expansion or contraction. Prior to testing the pipe, the pipe shall be center loaded with backfill between joints before testing to prevent the pipe from arching or whipping under pressure. During backfill the line shall be pressurized to 25 psi to minimize impact damage.

V. All valves shall be installed with their stems horizontal or above. As far as possible, all valves of the same type shall be of the same manufacturer.

W. Polypropylene pipe installation for laboratory use shall be in accordance with Contract Drawings, the manufacture’s recommendations, and the local plumbing code. Entire system shall be installed free of stress and in proper alignment without strain. Horizontal supports shall be split ring or clevis type hanger spaced in accordance with manufacturer’s recommendations. Vertical supports shall be standard riser clamps at each floor. Piping components shall be fused electronically with a Chem-Fuse power unit. Output voltage and fusion time shall be automatically controlled by the power unit. Connections between Chem-Fuse and other types of piping materials shall be made with Chem-Fuse adapters. Contractor shall provide, at no additional cost, on-site training for installation/maintenance personnel. Installation shall be in accordance with the manufacturer’s printed instructions, system design drawings, and applicable local codes. System testing shall be in accordance with local plumbing codes. Air or compressed gas is not recommended and should not be used as a media for testing Chem-Fuse piping systems.

3.02 EQUIPMENT CONNECTIONS

A. The plumbing contractor shall make all connections where required between the various piping systems and all pieces of equipment. This shall include adapters, traps, backwater valves, or other fittings required when not furnished with the equipment.

B. Unions - Provide a union or flange in piping connections to each valve, device, or item of equipment, and elsewhere as required to makeup or disconnect piping. Each union shall be so installed as to permit the removal of parts and equipment for inspection and cleaning, and shall be installed in a position which will permit the valve device or part to be removed without disconnection of any piping except unions. Union and flange shall be installed in such a position as will be accessible for disconnection items which are to be screwed.

3.03 TESTING AND ACCEPTANCE

A. Each pressure pipe system shall be tested hydrostatically at 150% of its operating pressure, unless otherwise stated in the Code. Test pressures and durations will be set by the Engineer and each test will be approved only after he has witnessed satisfactory pressures at the end of each test run.

B. The drains and vent lines shall be tested by filling the entire system with water to the highest point of overflow. After the pipes have stood full for 15 minutes, all joints and connections to fixtures shall be observed.

C. After all leaks have been repaired and approved, the lines and plumbing fixtures shall be flushed clean with hot water and left in a sanitary condition. The outside surfaces of pipes and equipment shall be cleaned of grease and dirt by a cleaning compound, then washed with water and allowed to dry.

D. The working temperature and pressure conditions shall be imposed on piping systems for a sufficient length of time to insure that flanges and bolts or studs have reached a point of constant temperature and have attained such changes in dimensions as will take place, after which all flanged joints and fittings on all equipment shall be retightened by the Contractor.

E. Where system operating temperature is above 200 degrees F, joints shall be retightened after 200 hours of service at operating conditions.

3.04 PIPING, FUEL GASES

A. Goosenecks with moth screens are required on all natural and digester gas roof vents.

B. Gas piping is to be installed by local or state codes or the local authority, whichever is more stringent. Installation to conform to ANSI Z223.1 (1984) and subsequent revisions.

C. Plastic piping to be installed with No. 12 TW copper wire tapered to pipe as tracer wire.

3.05 DISINFECTION OF WATER MAINS

A. After the pressure test and prior to disinfecting the lines shall be thoroughly flushed through hydrants, fixtures, or by other means as approved by the Engineer.

B. The Contractor shall furnish required materials and apparatus and perform the Work of disinfection. All temporary and permanent materials and apparatus and appurtenances shall have the same NSF61 approval as the installed Work.

C. All water lines shall be cleaned and disinfected in accordance with Federal, State, and Local Codes and AWWA C651 as follows:

1. Liquid sodium hypochlorite applied by means of a suitable solution feed machine or pump. Sodium hypochlorite storage conditions and durations shall be controlled to minimize deterioration.

2. Calcium hypochlorite applied as tablets, or powder. Tablets or powder shall be placed in the water line during construction. The water line shall be filled carefully, with potable water to produce a uniform solution.

3. Calcium hypochlorite applied as a water mixture. The calcium hypochlorite powder shall be mixed with water to form a paste and then thinned to a slurry, to be introduced into the pipe by pumping.

D. The dosage of chlorinating agent shall be of the amount to produce a minimum chlorine residual of 50 parts of chlorine per million. Tests with the DPD drop dilution method shall be made at selected points to determine the residual.

E. Treated water shall be retained in the lines for sufficient time to accomplish the desired disinfection but not less than 24 hours. Valves in the line shall be operated during the retention period.

F. Following disinfection, all treated water shall be flushed from the lines at their extremities until the replacement water throughout the lines shall, upon testing, be chemically and bacteriologically acceptable.

1. Two or more successive sets of samples taken at 24-hour intervals shall indicate microbiologically satisfactory water before the lines are placed into service.

2. Should the initial treatment prove ineffective, the disinfection shall be repeated until the test shows acceptable results.

G. All testing shall be done by a laboratory acceptable to the public authority having jurisdiction, and all costs shall be paid for by the Contractor.

PART 4 SPECIAL PROVISIONS

4.01 PIPING SERVICE MATERIAL REQUIREMENTS

A. The following are the material classifications to be used for the piping service identified.

Service	Piping	Gaskets
City Cold Water, Buried	DIP	N/A
City Cold Water	PE or PEX	N/A
City Hot Water	PEXa	N/A
City Tempered Water	PEXa	N/A

4.02 INSULATION FOR PIPES

A. Pipe insulation shall be as specified in Section 15504.

END OF SECTION

SECTION 15430
PLUMBING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all necessary plumbing specialties and components, connecting piping, and accessories.

B. Additional product requirements are specified in Section 01350.

C. All equipment, materials, and Work shall comply with Federal, State, and local plumbing codes. Equipment materials and Work specifically required by Federal, State, or local plumbing codes whether or not shown on the Drawings or specified shall be provided by the Contractor at no change in Contract Price.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
    a. Manufacturer's literature.
2. Information for the Record.
    a. Material certificates.
    b. Licenses and permits.
    c. Operation and maintenance manual.

1.03 CONTRACT DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping.

B. The exact location of apparatus, specialties, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

1.04 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All specialties, and appurtenances shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed specialties from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any specialties damage after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the specialties cleaned and ready for use.

PART 2 PRODUCTS

2.01 HOSE BIBBS

A. Hose bibbs inside buildings shall be all bronze angle hose valves Crane No. 117 or equal, with 3/4-inch standard threaded hose connections.

2.02 RESERVED

2.03 RESERVED

2.04 RESERVED

2.05 FLOOR, EQUIPMENT, AND AREA DRAINS

A. Type “B” drains with discharge piping below the slab shall be furnished with a dura-coated cast iron body and round heavy duty 9-inch diameter cast iron slotted grate. A backwater valve shall be furnished with the drain unless otherwise called for on the Drawings. A deep seal trap and adjustable cleanout shall be provided. Drain shall be a Zurn Z-511-1, Josam 36100-60, or equal. Trap and cleanout shall be a Zurn Z-1012-2, Josam 88030, or equal. Equipment shall be of the size and include auxiliary inlet connections as called for on the Drawings or required to finish the Work.

B. Exterior area of drains and area drains in unheated areas shall be provided as shown on the Drawings. Such drains shall be Zurn Type Z-506 or Z-509; Wade Type W-1710MS or W-1430; or equal. In-line traps with cleanouts shall be provided as shown on the Drawings.

C. Floor drainage systems shall be vented.

D. Floor sinks shall be 12-inch square rim with one-half nickel brass or bronze grate and aluminum dome strainer. They shall be Wade W-2534F, Zurn ZN-1800, or equal. A deep seal trap and adjustable cleanout shall be provided. Trap and cleanout shall be Zurn Z-1012-2, Josam 88030, or equal.

E. Cleanouts for vertical stacks shall be Zurn Supreme CO tee No. Z-1445-1 or equal with cadmium plated, cast iron, countersink, plug with round, smooth, stainless steel cover.

F. Cleanouts located in poured concrete floors or slabs shall be Zurn Heavy Duty CO No. Z-145001 or equal with round, scoriated, cast iron, non-tilt top.

2.06 PRESSURE GAUGES AND THERMOMETER

A. Pressure gauges shall be 4-1/2-inch in size with fiberglass reinforced polypropylene case, phosphor bronze bourdon tube, 6-inch or 4-1/2-inch dial faces with black lettering, micrometer type pointers and an accuracy of plus 1% of scale range. Pressure gauge shall be H.O. Trerice No. 450 series, Ashcroft 2462 series, or equal.

B. Pressure gauges shall read in pressure or compound as required by use.

C. All pressure gauges unless otherwise directed shall include a brass pressure snubber and a needle type shut-off valve.

D. Where directed, pressure gauges shall have diaphragm seals. The gauges, seals, and snubber shall be factory assembled and filled with fluid. The diaphragm seal shall be Type 316 stainless steel with a stainless-steel housing. Diaphragm seal shall be an Ashcroft 101 series, H.O. Trerice 877-2 series, or equal.

E. Thermometers shall be of the mercury in glass type with 9-inch C scale of proper range for the service shown and an adjustable angle mount. The thermometer shall be an H.O. Trerice BX9, US Gauge, or equal.

F. Thermometers shall be placed in piping at the following locations and elsewhere as noted:

1. In AH and AMU units coil inlet and outlet.
2. In domestic hot water heater and/or storage tank.
3. In designated pump inlet and discharge piping.

G. Pressure gauges and thermometers shall be installed as shown on the Drawings.

2.07 MISCELLANEOUS PRODUCTS

A. Shock Absorbers - Josam “Absorbotron,” Zurn, or equal, as noted on the Drawings.

B. Relief Valves - All brass, Crane No. 2606, Kennedy, or equal; pipe to floor.

C. Pipe Escutcheons - Split-type escutcheons shall be used for piping through finished walls, floors, or ceilings. Escutcheons shall be of brass or chromium plated.

D. Cleanouts - Zurn Z-1440-1, Josam 58710, or equal, for wall mount. Zurn Z-1425-27, Josam 58140, or equal, for floor mount.

E. Vent Stack Sleeve - Zurn Z-196, Josam, or equal.

2.08 BACKFLOW PREVENTERS

A. Reduced pressure type backflow preventers shall conform to ASSE Standard 1013, AWWA C511, and be approved by the State Department of Public Health, the State Plumbing Board, and the State Department of Labor-Construction Code. Preventers shall be Watts No. 909 with strainer, or equal. Relief valve shall be provided with an air gap, Watts Series AG or equal, piped to drain.

B. All backflow preventers are to include an in-line strainer between the stop valves.

2.09 ELECTRIC TANKLESS WATER HEATER

A. Manufacturer: Eemax Model PA018277T2T, or equal.

B. Tankless type water heater, flow controlled with nickel chrome replaceable cartridge insert element. Heater shall be fitted with 1/2 inch water connection compression fittings and electrical entry located on the bottom of the unit with powered coated steel cover. Unit shall have high temperature limit switch with automatic reset. Minimum pressure rating of 35 psi, maximum pressure rating of 150 psi. 18 KW, 480/3/60, non-thermostatic, flow controlled.

2.10 RESERVED

2.11 WATER TEMPERING VALVES

A. Hot water and cold and/or return water shall be mixed by the tempering valve producing a tempered water supply (TWS) for hose bibb.

B. Valve to be completely constructed of brass and tested to 300 psig. Thermostatic element to have a minimum length of 11-inch.

C. Valve to be adjusted to the setpoint shown on the Drawings. Holby or equal.

D. Capacities:

1. HW 2.25 GPM at 80 degrees F
2. CW 0.75 GPM at 40 degrees F
3. TWS 3.0 GPM at 70 degrees F

2.12 RESERVED

2.13 RESERVED

2.14 RESERVED

2.15 WATER METER

A. Provide two water meters, Senses Technologies, Uniontown, PA, Model Number W-1000 DR or equal. Meters shall be bronze with magnetic drive, 4-inch flanged for intermittent flows of 15 gallons per minute to 1,250 gallons per minute at an accuracy of 1.5% of actual throughput.

B. Pressure loss shall be 5.0 psig at 1,000 gallons per minute. Register shall be hermetically sealed direct reading with low indicator. Registration shall be in gallons per minute.

C. Case shall be bronze with bronze and thermoplastic measuring chamber, thermoplastic rotor, graphite radial bearings, stainless steel trim, tungsten carbide thrust bearings, ceramic magnets, and thermoplastic straightening vanes.

D. Provide a Rockwell HSP high speed pickup register with a minimum of 40 feet of Belden No. 8770 shielded cable for signal transfer to remote instrument location. Input shall be 12-VDC current at 50 milliamps. Output signal shall be a high frequency pulse compatible with the instrumentation.

E. Provide a Rockwell Model 1006A ACT-PAK flow rate indicator with analog indication. Unit shall be fully compatible with the meter and high speed pickup register and be capable of providing a 4-20 milliamp output signal, proportional to the flow rate, with 500 ohms maximum impedance. Operating requirements shall be 117/1/60 three wire circuit with a maximum of 10 watts maximum power consumption. Unit shall operate in 0-degree F to 120-degree F, at 80% maximum RH.

2.16 EXPANSION JOINTS

A. For pipe sizes 1/2-inch to 3/4-inch use an Arch Type, Holz Rubber Co., Model 300 or Owner approved alternate.

B. Joints shall be single arch type with control rods and plates. Joints shall have a one-piece elastomer leak free tube compatible with the process fluid. The manufacturer shall select the tube material.

C. For pipe sizes 2-inch up to 4-inch use a Mercer style 500 or Owner approved alternate. Joints shall be a single arch type with control rods and plates. Joints shall have a one-piece elastomer leak free tube compatible with the process fluid. The manufacturer shall select the tube material.

2.17 RESERVED

2.18 RESERVED

2.19 RESERVED

2.20 RESERVED

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide batt insulation around roof drain bodies and within roof opening cavities. Install underdeck clamp/escutcheon plate to cover underside of roof opening and contain insulation.

C. Extend clean-outs to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to sinks, quick closing valves, and long dead-end runs.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15440
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all necessary plumbing fixtures and components, connecting piping, and accessories.

B. Additional product requirements are specified in Section 01350.

C. All equipment, materials, and Work shall comply with Federal, State, and local plumbing codes. Equipment materials and Work specifically required by Federal, State, or local plumbing codes whether or not shown on the Drawings or specified shall be provided by the Contractor at no change in Contract Price.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

    a. Manufacturer's literature.

2. Information for the Record.

    a. Material certificates.

    b. Licenses and permits.

    c. Operation and maintenance manual.

1.03 CONTRACT DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping.

B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

1.04 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All fixtures, and appurtenances shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any fixture damage after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the fixtures and equipment cleaned and ready for use.

PART 2 PRODUCTS

2.01 PLUMBING FIXTURES

A. Plumbing fixtures shall be a product of one of the following manufacturers:

Item	Manufacturer
Mop Sinks	Powers-Fiat, Mark Controls Corp., or equal

B. The model numbers and manufacturers listed are to establish the type, style, quality, and materials of construction required. All individual shower mixing valves shall be ANSI/ASSE 1016 approved and be identified as a Type T (automatic water temperature regulations) or a Type P (automatic pressure balancing) regulator. All primary temperature actuated mixing valves shall be ANSI/ASSE 1017 approved.

1. Mop Sink - Crane MSG 24 by 24 with Model 830-AA faucet.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Rough in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install each fixture with trap; easily removable for servicing and cleaning.

C. Provide chrome-plated, rigid or flexible supplies to fixtures with loose key screwdriver stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900; color to match fixture.

G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

H. Install electric heat trace tape, insulate, and cover with weather-resistant plastic jacket on the exposed water supply piping to the inlet of the outdoor emergency eyewash and shower unit.

3.04 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

A. At completion clean plumbing fixtures and equipment.

3.06 PROTECTION OF FINSIHED WORK

A. Do not permit use of fixtures.

3.07 PIPE SIZE TO FIXTURES

A. Unless otherwise shown on the Contract Drawings, the water supply and drainage connections to fixtures shall not be sized less than shown in the following schedule:

	Waste (inch)	Vent (inch)	Trap (inch)	Cold Water (inch)	Hot Water (inch)
Mop Sink	3	1 1/2	3	1/2	1/2
Hose Bib					¾ (temped)

B. Stops or Gate Valves shall be installed in hot and cold-water supply to each fixture or piece of equipment. Install union connections on fixture side of stop or gate valve at each fixture.

C. Fixture Supports - For support of wall hung fixtures, secure fixture hangers to wall with not less than 5/16-inch toggle bolts. No lead shields will be allowed.

D. Mounting Heights - All fixtures shall be set in a neat, finished, and uniform manner, making connections with all supply, waste, soil, and vent pipes. Fixture heights shall be the distance from floor to rim of fixtures, fitting heights shall be to centerline of fitting, and shall conform to the following unless otherwise specified:

Service Sink Faucets	30-inch

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 15504
MECHANICAL SYSTEMS INSULATION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision to install insulation work including insulation, cements, mastics, adhesives, attachment pins, studs or clips, covering, lagging, jackets, hardware, flashing and finishes.

B. Work shall be complete, in full conformance with the material manufacturer's requirements and recommendations, applicable national standards, the National Insulation Contractors Association, National Commercial, and the Industrial Insulation Standards.

C. All insulation as applied shall meet or exceed the requirements of this Section or ASHRAE/IES 90.1 whichever is greater.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. A complete description of each insulation system.

c. Plate submittals for tanks and vessels as identified by NICA, Current Edition.

d. Vendor information and catalog data detailing each component of the system including the method of fastening.

e. Design information for fiberglass duct systems including size and spacing of reinforcement system proposed.

2. Information for the Record:

a. Substantiation of vendor compliance with codes, standards, or test methods noted herein.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials furnished under this specification shall be standard, catalogued products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free of all defects.

B. Materials include insulation materials, accessories (staples, bands, mesh, wire, clips, pins, tape, anchors, corner angles, and similar recommended accessories) and compounds (cements, adhesives, coatings, sealers, protective finishes, and similar items recommended for the applications indicated).

C. The Contractor, unless clearly otherwise stated, shall supply materials which meet the owner's requirements with respect to the design criteria, thermal conductivity, and standards.

D. The Contractor shall warrant that materials furnished and installed be free of defects for a period of one year from the time the system is completed.

E. If a defect occurs in materials, workmanship, or application within the stated time, the Contractor shall promptly repair or replace the defect. Damages caused by others shall be repaired at the expense of the damaging party.

F. Specified components of the insulation system, including facings, mastics, and adhesives should have a fire hazard rating not to exceed 25 for flame spread, and 50 smoke developed, as tested under ASTM E84.

G. All accessories and materials (i.e. coatings, adhesives, sealers, etc.) are to be shipped to the job site in marked, unopened containers as received from the manufacturer.

H. Provide and install insulation, cements, mastics, adhesives, covering, lagging, flashing, and finishes in full conformance with the material manufacturer's requirements and the recommendations, applicable national standards, the National Insulation Contractors Association, and the Industrial Insulations Standards.

2.02 PIPING SYSTEMS

A. Solid foamed closed cell (Insulation Class CG) shall be constructed of closed cell glass bubbles conforming to ASTM C552, Pittsburgh Corning Foamglass, or equal. Conductivity shall be 0.33 Btu-inch per hour-square feet-degrees F.

B. Flexible foamed plastic closed cell (Insulating Class FP) shall conform to ASTM C534, Armstrong Armaflex II, Manville Rubatex, or equal. Conductivity shall be 0.28 Btu-inch per hour-square feet-degrees F. Outside installation finish shall be two coats of Armaflex Finish or Rubatex 374. Insulation shall not be constructed of polystyrene, polyisocyanurate, or polyethylene/polyolefin materials.

C. Fiberglass (Insulating Class LT) shall conform to CertainTeed Manson Alley-K Snap-On Fiber Glass Pipe insulation with factory applied all service jacket and self-sealing lap. The insulation shall be one-piece with a k value of 0.23 Btu-inch per hour-square feet-degrees F at 75 degrees F.

D. Duct insulation (Insulation Class DW3) shall conform to ASTM -1136 and ASTM C612, 3 pounds per cubic foot density, CertainTeed Manson, Malvern, PA.; IB 300, Great Lakes Textiles, Walton Hills, OH; Rigid Wrap, or equal. Interior installations shall be faced with FSK. Conductivity shall be 0.23 Btu-inch per hour-square feet-degrees F at 75 degrees F.

E. Insulation thickness shall be as specified in Part 4.

F. Aluminum lagging shall be 0.016-inch thick with banding straps on minimum 18-inch centers and at each joint.

G. Plastic lagging or jacketing shall be Manville Zeston 2000 PVC, CertainTeed Manson, or equal.

2.03 HEATING, VENTILATION AND AIR CONDITIONING INSULATION

A. Unless noted on the Drawings, all ducts shall be covered with insulation.

B. Duct insulation (Insulation Class DW) shall be 1.5 pound per square foot, 3-inch thick fiberglass with reinforced foil vapor barrier facing, Owens Corning All Service Faced Duct Wrap, or equal. Thermal conductivity shall be 0.3 or less as measured by ASTM C518.

C. Duct insulation (Insulation Class OA) shall be AP Armaflex or AP Armaflex SA and shall conform to ASTM C534, Type II--Sheet. The material shall have a water vapor transmission of 0.10 perm-inches or less. The exterior surface shall be finished with two coats of Armaflex WB or SB Armaflex finish. Thermal conductivity shall be a maximum of 0.27 Btu-inch per hour. Insulation shall not be constructed of polystyrene, polyisocyanurate, or polyethylene/polyolefin materials.

D. Duct insulation liner (Insulation Class ID) shall be Knauf Duct Liner EM or equal. Thermal conductivity shall be a maximum of 0.25 Btu-inch per square feet hour-degrees F.

E. Duct insulation (Insulation Class DB) shall be CertainTeed Manson, Malvern, PA., type IB200, or equal and shall conform to ASTM C518 and ASTM C177. Material shall be 2 pounds per cubic foot destiny and shall have a maximum conductivity of 0.35 Btu-inch per square feet-hour-degrees F.

2.04 RESERVED

PART 3 EXECUTION

3.01 GENERAL

A. All insulation work shall be performed by skilled mechanics regularly engaged in the insulation trade.

B. The Contractor shall be responsible for coordination and cooperation with the Owner and other trades so that the installation is performed with minimum interference and conflict.

C. The final appearance of the insulation work shall be a neat, workmanlike and attractive insulation system.

D. Progressive testing of systems to be insulated shall have been completed, inspected, and approved by Owner’s representative before insulation is applied.

E. Insulation shall not be applied until all surfaces are clean, dry, free of dirt, dust, grease, frost, moisture, and other imperfections.

F. Suitable application temperature and conditions shall be provided by others.

G. Insulation shall be protected from moisture and weather during storage and installation. Applied insulation which has become wet shall be thoroughly dried before it is sealed or jacketed.

H. The Contractor shall not arc-weld brackets, clips, or other devices to ASME coded pressure vessels or piping. Insulation pins or studs shall be as specified and installed in accordance with acceptable standards.

I. Insulation, fabric, and jacketing shall be protected from mechanical damage during construction. Damage by the insulator shall be repaired without cost to the Owner.

J. Contractor is responsible for proper material storage at the Work site.

K. Work performed prior to receipt of approved documents or submittals, which later proves to be incorrect or inappropriate, shall be promptly replaced by the Contractor without cost to the purchaser.

L. Insulation shall not be installed until adequate access and clearances at control mechanisms, dampers, sleeves, columns, and walls have been provided.

M. All insulation at handholes, access doors, or other openings, and adjacent to flanges and valves shall be neatly finished where exposed to view.

N. Where insulated pipes or ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening.

O. Vapor barriers shall be continuous through sleeves, hangers, etc. If pierced, vapor barriers shall be covered and suitably resealed.

3.02 INSTALLATION

A. Pipe insulation shall include all fittings, valves, (including bonnets) piping specialties, pumps, tanks, and heat exchangers.

B. Prior to insulating, all required inspections, examinations, and tests (such as hydrostatic tests, air pressure tests, and heat tracing tests) shall be successfully completed.

C. All insulation shall be well secured to the item being insulated, by means of wire, clips, studs or other proven fasteners.

D. All fittings, flanges and valves shall be insulated with block, preformed or sectional insulation of the same material as adjacent pipe material, except on sizes up to 3-inch, two or more layers cemented in place may be used to obtain the required thickness of insulation.

E. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks and depressions shall be pointed with cement. When irregular or compound shapes require insulation be cut and fit, all gaps shall be filled. Cut and fit jacketing shall be free of jagged edges and shall provide complete coverage.

F. Insulation of any pipe line or any other item shall include insulation of all take-off connections (including those for instruments, controls, vents, drains or sampling) and all

branch connections, up to and including the first valve in the take-off connection or branch connection.

G. Double layer insulation shall have staggered joints. Each layer shall be wired in place.

H. Insulation on vertical pipes shall have provisions which preclude eventual gaps in the insulation as a result of pipe expansion, settling, or shrinking of the insulation, or other causes. The provision may be intermediate supports, insulation “expansion joints” or other means approved by the Engineer.

I. All welding (including stud welding and other attachment on boiler, pressure vessels, piping systems and equipment) shall conform to applicable codes and standards.

J. At each pipe hanger or support, the insulation shall accommodate the hanger or supports and its anticipated movement.

K. Insulation work on all items (including boilers, pumps, vessels, etc.) shall conform to the requirements and recommendations of the respective manufacturers.

L. Insulation work of all of the following items shall be blankets which are designed to allow removal, reuse and replacement of the insulation work:

1. Flanges, 6-inch NPS or larger.

2. Manholes, handholes, and other access devices.

M. Insulation on heat traced pipe lines shall be such that the specified nominal thickness of insulation is uniformly maintained around the pipe.

N. The Contractor shall identify and insulate all Personnel Protection Areas and insulate as necessary in accordance with the following:

1. All points where personnel can easily come in contact with hot surfaces.

2. Areas are to include all hot surfaces within an elevation of 7-feet and with 2-feet of the sides of all access zones, walkways, platforms, working areas, or stairways and ladders.

O. Insulation Class DW shall be installed as noted in National Commercial & Industrial Insulation Standards - 1988, as published by Midwest Insulation Contractors Association. The method shown on plate 19 shall be used for interior ducts, and that shown on plate 20 shall be used for exterior ducts. Staple - stitching shall not be used.

P. Ducts carrying 100% outside air from a conditioning unit within 20 feet of the building served are not required to be insulated.

Q. All external lines insulated above ground shall be enclosed with Class CG insulation and aluminum lagging. All external insulated lines belowground shall be enclosed with Class CG insulation and coated with Pittcote 300 and Pitwrap SSII.

R. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks, ends, and depressions shall be pointed with cement or mastic as recommended.

3.03 OWNER'S ACCEPTANCE

A. All materials, accessories, and methods of installation and fabrication are subject to the Owner's inspection and approval during any phase of the Work.

PART 4 SPECIAL PROVISIONS

4.01 PAINTING

A. All pipe, equipment, and tank insulation shall be painted as required by Section 09900 except in B. below.

B. Pittcote 404 shall be installed by this Contractor with color selection by the Owner.

4.02 PIPE INSULATION AND JACKET SCHEDULE

A. Class CG insulation when installed inside X Building(s) shall be jacketed with (all service jacket (ASJ) (And painted as required in Section 09900).

PIPE INSULATION SYSTEM REQUIREMENTS SCHEDULE						
Pipe Line	**Size**	**Pipe Class***	**Ins. Thickness**	**Lagging***	**Finish**	**Comments**
Hot Water System	to 2"	LT	1-1/2"	Plastic	Color by Owner	
Chilled Water 40 degrees F to 55 degrees F	All Sizes	LT	1"	Plastic	Color by Owner	
Domestic and Nonpotable Water, Hot or Cold	to 2"	FP	1"	Plastic	Color by Owner	
Domestic and Nonpotable Water, Hot or Cold	2-1/2" and above	FP	1-1/2"	Plastic	Color by Owner	
Ductwork	All Sizes	AL-Duct	2"	Hardcast DT-5300	Color by Owner	R-6

Note: * All external lines insulated above ground shall be enclosed with Class CG and Aluminum Lagging.

* All external insulated lines below ground shall be enclosed with Class CG with Pittcote 300 and Pittwrap SSII.

* Special conditions, in certain areas, may require a variance for insulation type, thickness, and lagging. Contractor to verify specific requirements on Drawings.

** This insulation system shall be used for four cycle engine exhaust systems.

All heat traced lines shall be insulated as noted on the drawings.

END OF SECTION

SECTION 15550
BOILERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing of all materials, equipment, labor, and supervision related to the furnishing and installing the boiler and necessary for the completion of the Work in accordance with the Contract Documents.

B. All Work performed under this Section shall comply and be in accordance with all approved trade practices, all applicable state and local codes, and manufacturer's recommendations.

C. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements in Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Descriptive literature, bulletins, or other data describing the boiler.

   c. Complete list of equipment and appurtenances included with the boiler complete with manufacturer's name and model number.

   d. General arrangement and dimension drawings.

   e. Sectional assembly drawing.

   f. Materials of construction.

2. Information for the Record:

   a. Copy of state or local registration providing permission to install and repair boilers.

3. Operation and maintenance manual.

PART 2 PRODUCTS

2.01 BOILER

A. The boiler shall be a LOCHINVAR Crest Model FBN1751 having a modulating input rating of 1,684,000 Btu/Hr, an output of 1,464,000 Btu/Hr and shall be operated on Natural Gas.

B. The boiler shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The boiler shall have a fully welded, stainless steel, water tube heat exchanger. Multiple pressure vessels in a single enclosure are not acceptable. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 2.2 psi at 75 GPM. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.

C. The heat exchanger shall have a volume of water no less than 8.8 gallons

D. The boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The boiler shall comply with the energy efficiency requirements of the latest edition of ASHRAE 90.1 and the minimum efficiency requirements of the latest edition of the AHRI BTS-2000 Standard as defined by the Department of Energy in 10 CFR Part 431. The boiler shall operate at a minimum of 96% Combustion and Thermal Efficiency at full fire as registered with AHRI. The boiler shall be certified for indoor installation.

E. The boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The boiler shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The boiler shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.

F. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The boiler shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue

temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.

G. The BOILER shall feature the "SMART TOUCH™" control with CON-X-US which is standard and factory installed with an 8" liquid crystal touch screen display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities and PC port connection. A secondary control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in "Cascade" to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The control must include cascade redundancy to allow a member boiler to become the temporary leader if the original lead boiler shall loose communication with the members. The boiler shall be capable of controlling an isolation valve (valve shall be offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must be equipped with standard BACnet MSTP and Modbus communication protocol with a minimum 55 readable points. The BOILER shall have an optional gateway device which will allow integration with LON or BACnet (IP) protocols.

H. The "SMART TOUCH™" control shall include CON-X-US communication platform that will allow remote access via a smart phone or Tablet. This will allow the ability to monitor and manage multiple KNIGHT XL Boilers and send alerts via text or e-mail notifying of changes in system status. A user shall have the ability to check system status or re-program any boiler function remotely.

I. The "SMART TOUCH™" control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0 -10 VDC output signal shall control a variable speed boiler pump (pump to be offered by manufacturer) to keep a fixed delta t across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0 – 10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues and erratic temperature cycling.

J. The boiler shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 44 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral

relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.

K. The boiler shall be installed and vented with a (select one):

1. Direct Vent system with horizontal sidewall termination of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of PVC, CPVC, Polypropylene or Stainless Steel. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 150 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 150 equivalent feet.

L. The boiler shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacturer shall verify proper operation of the burner, all controls and the integrity of the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

M. The boiler shall be suitable for use with polypropylene glycol up to a 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.

2.02 RESERVED

PART 3 EXECUTION

3.01 INSTALLATION

A. Boiler shall be installed on a 6-inch high concrete pad and connected to piping and masonry flue as shown on the Drawings.

B. Two copies of manufacturer's data reports shall be furnished and approved prior to start-up.

C. Disconnect and power wiring to control cabinet on burner will be provided under the Division 16.

D. Installation shall be complete and in accordance with the manufacturer's recommendations, Engineer's instructions, and the Contract Documents.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15720
INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SCOPE

A. Section includes modular factory fabricated air-handling units and accessories.

B. This Section shall include but not limited to all appurtenances required for complete installation.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

E. Additional product requirements are specified in Section 01350.

1.02 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 – Standards Handbook.
2. AMCA 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
3. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.
4. AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
5. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

C. National Electrical Manufacturers Association:

1. NEMA MG 1 – Motors and Generators.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA – HVAC Duct Construction Standard – Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 900 – Air Filter Units.

2. UL – Fire Resistance Directory.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

2. Product Data, Submit the following:

a. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

b. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

c. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

d. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.

e. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.

f. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

3. Information for the Record:

a. Operation and maintenance manual. Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.04 QUALITY ASSURANCE

A. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

3. Protect units from weather and construction traffic by storing in dry, roofed location.

1.06 EXTRA MATERIALS

A. Furnish two spare sets of fan belts for each unit.

B. Furnish three spare sets of filters for each unit.

PART 2 PRODUCTS

2.01 AIR HANDLING UNITS

A. Manufacturers:

1. Trane Technologies.

2. Carrier Corporation.

3. Daikin/McQuay.

4. Or equal.

B. Configuration: fan and coil section plus accessories, including:

1. Heating coil.

2. Filter section.

3. Face and bypass damper section.

C. Performance Base: Sea level pressure or altitude.

D. Fabrication: Conform to AMCA 99 and ARI 430.

2.02 CASING

A. Channel base and drain pan of welded steel. Assemble sections with gaskets and bolts.

B. Outside Casing:

1. Aluminum: 0.063 inch thick.

2. Steel: 0.06 inch thick.

3. Galvanized Steel: 0.0635 inch.

4. Stainless Steel: 0.0625 thick.

C. Inside Casing:

1. Aluminum: Solid 0.32 inch thick.

2. Galvanized Steel: Solid, 0.0276 inch thick.

3. Stainless Steel: Solid, 0.025 inch thick.

D. Floor Plate:

1. Galvanized Steel: 1.382 inch thick.

2. Stainless Steel: 0.1406 inch thick.

E. Insulation: Neoprene coated, glass fiber, applied to internal surfaces with adhesive with exposed edges of insulation coated with adhesive.

1. 'K' factor at 75 degrees F: Maximum 0.26 Btuh inch/ sq ft/ degrees F.

2. Density: 1 1-1/2 2 inch thick, 1-1/2 lbs./cu ft.

F. Finish: Baked enamel Zinc chromate, iron oxide, phenolic resin paint Asphalt base coating formulated to protect surfaces, to seal seams and joints, and to provide insulation and sound deadening Three coat system of epoxy applied over shot-blasted surface, to total thickness of 5-6 mils.

G. Inspection Doors: 18 x 46, 18 x 46, 29 x 46 inch of galvanized steel for flush mounting, with gasket, latch, and handle assembly and 1/4-inch-thick Plexiglas inspection window. Furnish welded channel frame to set door out from casing to permit external insulation.

H. Lights: Located in accessible sections suitable for damp locations with wire guards, factory wired to weatherproof switch and pilot light and duplex outlet mounted on casing exterior. In humidifier sections, furnish lights suitable for wet locations.

I. Drain Pans: Double thickness galvanized steel with insulation between layers with welded corners. Cross break and pitch to drain connection. Furnish drain pans under fan section heating coil section mixing section plenum sections with asphalt base coating.

J. Bottom Inlet Units: Furnish steel or aluminum walking grate on structural supports.

K. Strength: Furnish structure to brace casings for suction pressure of 2.5 inch wg, with maximum deflection of 1 in 200.

2.03 FANS

A. Type: Plenum fan, dd plenum, full width, h press type fan.

B. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with [plastic] [aluminum] [copper] tube and grease fitting rigidly attached to casing.

E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. Furnish built-in

inertia base of welded steel with bottom sheet and reinforcing grid for concrete ballast. Mount base on vibration isolators.

F. Fan Modulation: Variable frequency drive (VFD). Refer to Division 16.

G. Flexible Connection: Separate unit from connecting ductwork.

2.04 MOTORS

A. Refer to Division 16 for motor requirements.

2.05 BEARINGS AND DRIVES

A. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 11, L-10 life at 120,000 hours L-50 life at 400,000 hours.

B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.

D. Belt Guard: Fabricate to SMACNA Standard; 0.106 inch thick, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.06 COILS

A. Casing with access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24-inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of Type 304 stainless steel mounted over drain pan.

D. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

E. Fabrication:

1. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints.

2. Fins: Aluminum.

3. Casing: Die formed channel frame of galvanized steel.

F. Water Heating Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

2.07 RESERVED

2.08 FILTERS

A. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.

B. Filter Media: UL 900 listed, Class I approved by local authorities.

C. Flat Angle High Capacity: 2 inches 44 inches deep disposable panel filters.

D. Filter Gauges: 3-1/2 inch diameter diaphragm actuated dial in metal case with static pressure tips.

2.09 RESERVED

2.10 DAMPERS

A. Outside Air Damper Leakage: Maximum 3.0 cfm per square foot at 1.0 inches wg pressure differential.

B. Damper Leakage: Maximum 2 percent at 4-inch wg differential pressure when sized for 2000 fpm face velocity.

C. Damper Leakage: Maximum 3.0 cfm per square foot at 1.0 inches wg pressure differential.

D. Face and Bypass Dampers: Factory mount in casing with access doors, of galvanized steel blades, with vinyl bulb edging and edge seals, galvanized steel frame, and axles in self-lubricating nylon bearings. Arrange to match coil face with top bypass, blank-off and division sheets, internal linkage, access doors, and adjustable resistance plate.

E. Damper Actuators: Furnish factory installed electronic damper actuators for outside air, , and face and bypass dampers.

2.11 OUTSIDE AIR MEASURING AND MODULATION DEVICE

A. Factory mounted in outside air.

B. Damper and airflow measurement assembly sized to accommodate minimum outside airflow as indicated on Drawings.

C. Construction:

1. Frame: Extruded aluminum.

2. Blades:

a. Modulating Air Control:

1) Style: Airfoil-shaped, single-piece.

2) Action: Back-Parallel.

3) Orientation: Vertical.

4) Material: Heavy gage 6063-T5 extruded aluminum.

5) Width: Maximum 5 inches.

3. Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.

4. Seals:

a. Blade: Extruded rubber. Mechanically attached to blade edge.

b. Jamb: Stainless steel, flexible metal compression type.

c. Linkage: Concealed in frame.

d. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.

e. Mounting: Vertical.

f. Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.

5. Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.

6. Finish: Mill aluminum.

D. Performance Data:

1. Temperature Rating: Withstand -40 to 140 degrees F.

2. Accuracy: Plus or minus 5 percent.

3. Leakage: Maximum of 3.0 cfm per square foot at 1.0 inches wg pressure differential.

4. Measures from 15 percent to 100 percent of unit nominal air flow.

5. Adjusts air flow for temperature variations.

6. Provides 2 to 10 volt DC signal corresponding to actual air flow.

E. Accessories:

1. Actuator Heater: Allow actuator operation in ambient temperatures to -40 degrees F.

2.12 CONTROLS

A. Controls: Refer to Section 15980.

2.13 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory mount on equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with ARI 430.

B. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running. Refer to Section 15820.

C. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

D. Install floor mounted units on concrete housekeeping pads at least 4 inches high and 6 inches wider than unit. Refer to Section 03300.

E. Provide fixed sheaves required for final air balance.

F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 15081.

G. Connect humidifiers to water supply. Install gate valve on water supply piping. Install 3/4-inch hose bibb accessible from interior. Pipe drain and overflow to nearest floor drain.

H. Install condensate piping with trap and route from drain pan to nearest floor drain. Refer to Section 15180.

3.02 RESERVED

3.03 RESERVED

3.04 INSTALLATION HOT WATER HEATING COIL

A. Make connections to coils with unions or flanges.

B. Connect water supply to leaving airside of coil (counter flow arrangement).

C. Locate water supply at bottom of supply header and return water connection at top.

D. Install water coils to allow draining and install drain connection at low points.

E. Install the following piping accessories on hot water piping connections. Refer to Section 15120 and Section 15180.

F. Install valves and piping specialties in accordance with details as indicated on Drawings.

G. Install manual air vents at high points complete with shutoff valve. Refer to Section 15180.

3.05 RESERVED

3.06 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish services of factory trained representative for minimum of one days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.07 CLEANING

A. Section 01700 - Execution Requirements: Requirements for cleaning.

B. Vacuum clean coils and inside of unit cabinet.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.08 DEMONSTRATION

A. Section 01700 - Execution Requirements: Requirements for demonstration and training.

B. Demonstrate unit operation and maintenance.

C. Furnish services of manufacturer's technical representative for one day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner.

3.09 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

C. SPECIAL PROVISIONS

PART 4 SPECIAL PROVISIONS

4.01 SCHEDULES

Pipe Hanger Spacing		
Pipe Material	**Maximum Hanger Spacing Feet**	**Hanger Rod Diameter Inches**
ABS (All sizes)	4	3/8
Aluminum (All sizes)	10	1/2
Brass		
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10-foot length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Fiberglass	4	1/2
Glass	8	1/2
Polypropylene	4	3/8
PVC (All Sizes)	4	3/8
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

Note for Cast Iron Pipe: Provide close to joint on barrel. Also provide hanger at each change of direction and each branch connection.

END OF SECTION

SECTION 15739
SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to unitary air conditioning units and control necessary for the completion of the Work in accordance with the Contract Documents.

B. Section included controls, control wiring, and control wiring conduit for HVAC equipment less than 115 volts. Power wiring, power electrical conduit, power distribution panels, and circuit breakers, for HVAC equipment 115 volts and greater is included in Division 16.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. All wall, roof, and floor penetrations for any building modifications which are required for the installation of the Work under this Section shall be provided by this Section. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.

E. Equipment with a suitable factory finish shall not be painted unless the finish is damaged or the color does not match that of adjacent equipment. If the finish is damaged or the color does not match, the equipment shall be field painted under this Section in accordance with the requirements of Section 09900.

F. Certain electrical starters, disconnects, and wiring will be provided and connected to the electric motors and equipment under Division 16. The Contractor shall refer to the Electrical Drawings and Specifications for Work included under Division 16. All control wiring shall be included in this Section and shall be installed as required in Division 16.

G. Hangers, anchors, and supports provided by this Section shall be in accordance with Section 15010.

H. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

I. Provide and install all equipment specified within this Section. The Contractor shall perform all electrical installation for all voltages less than 115 volts.

J. All electrical work for all voltages, 115 volts and greater, shall be performed under Division 16, including but not limited to, motor operated dampers, motor operated valves, control panels, and line voltage thermostats provided by this Contractor.

K. Certain equipment furnished under this Section shall be connected to the plant control system by others as shown on the P&ID Drawings. Those connections and any remote

control connections shall be clearly labeled terminal strips within the equipment control panel.

L. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Descriptive information of all mechanical and electrical items used in providing a complete job.

c. Drawings locating anchors, inserts, and supports.

d. Complete list of accessories and appurtenances included with each item, complete with manufacturer's name and model number.

e. General arrangement and dimension drawings.

f. Section assembly drawings.

g. Materials of construction.

h. Certified capacity data.

i. Schematic wiring diagrams and electrical load requirements.

j. Shop Drawings shall include data for all equipment, piping, and valves, controls, accessories, and electrical apparatus to be supplied with equipment.

2. Information for the Record:

a. Operation and maintenance manual.

1.03 DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the Drawings shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make

minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

1.04 ELECTRICAL AND CONTROL COORDINATION

A. All equipment shall be powered electrically and wired as required in Division 16.

1.05 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All equipment and appurtenances shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed equipment from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any equipment damage after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the equipment cleaned and ready for use.

1.06 GENERAL REQUIREMENTS

A. Conform to applicable code for internal wiring of factory-wired equipment.

B. Heating units shall be UL listed and comply with the requirements of the National Electrical Code.

C. Contractor shall check electrical, architectural, and piping drawings for possible interferences and shall coordinate installation with other contractors.

D. Equipment shall be as indicated in the Specifications and on the Drawings.

PART 2 PRODUCTS

2.01 DUCTLESS SPLIT SYSTEM

A. Indoor Fan Coil Unit:

1. Make and Model: Carrier Model 40MHH, Trane, Mitsubishi, or equal.

2. General: Indoor, direct expansion, wall mounted fan coil, complete with cooling coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit is furnished with an integral wall mounting bracket and mounting hardware.

3. Unit Cabinet: Cabinet discharge and inlet grilles are attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

4. Fans: Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Provide and automatic, motor-driven vertical air sweep shall be provided as standard equipment. The air sweep operation shall be user selectable. Vertical sweep may be adjusted. The horizontal air direction may be set manually.

5. Evaporator Coil: The evaporator coil shall be constructed of copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and blue hydrophilic pre-coated. Drip pan shall be provided under the coil with a drain connection for the hose attachment to remove condensate and an internal trap.

6. Filter: Unit cabinet shall have a filter track with factory supplied cleanable filter.

7. Electric Motor: Motors shall be open drip-proof, with a permanently lubricated ball bearings. Fan motors shall be 4-speed.

8. Electrical Requirements: Indoor fan operates on 208-230V/1PH/60HZ. Power shall be supplied by the outdoor condensing unit.

9. Refrigerant Lines and Condensate Drain Hose: Provide pre-charged refrigerant line set with both refrigerant lines insulated. Foam insulated condensate drain hose shall discharge from the interior fan/coil unit to the exterior of the building at grade.

B. Outdoor Condensing Unit:

1. Make and Model: Carrier Model 38MHRB, Trane, Mitsubishi, or equal.

2. General: Factory assembled, single piece, air cooled outdoor condensing unit. Unit enclosure shall contain all the factory wiring, piping, controls, and the compressor.

3. Unit Cabinet: Constructed of galvanized steel, bonderized and coated with baked enamel finish on the inside and outside. Unit access panel is removable with minimal screws and provides access to the compressor, fan, and control components. The outdoor compartment is isolated and has an acoustic lining to assure quiet operation.

4. Fans: Outdoor fans shall be direct drive propeller type and discharge horizontally. Fans shall draw air through the outdoor coil. Outdoor fan motors shall be totally enclosed, single phase motors with Class E insulation and permanently lubricated ball bearings. Motor shall be protected by internal thermal overload protection. Motor shaft shall have inherent corrosion resistance. Fan blades shall be non-metallic and statically and dynamically

balanced. Fan openings shall be equipped with a PVC metal/mesh coated protection grille over the fan.

5. Compressor: Compressor shall be fully hermetic rotary type and equipped with an oil system, operating oil charge, and a motor. Motor is NEMA rated class E, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

6. Outdoor Condenser Coil: The coil shall be constructed of aluminum golden hydrophilic pre-coated fins mechanically bonded to seamless copper tubes, which shall be cleaned, dehydrated, and sealed.

7. Refrigeration Components: Refrigerant circuit components include a brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, and accumulator.

8. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. Minimum control functions include the following:

   a. A time delay control sequence provided standard through the fan coil board.

   b. Automatic outdoor fan motor protection.

   c. System diagnostics.

   d. Compressor motor current and temperature overload protection.

   e. Outdoor fan failure protection.

9. Electrical Requirements: Unit operates on 208-230V/1PH/60HZ power with single point connection. Unit control voltage to the indoor fan coil unit is 0-15V DC unless otherwise specified in Division 16.The unit shall be equipped with high and low voltage terminal block connections.

C. Controls: Controls consist of a microprocessor-based control system that controls space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range is from 62 degrees F to 86 degrees F in increments of 1 degree F. Wired controller features and functions:

1. Features:

   a. LCD display.

   b. Malfunction code display – displays error code.

   c. 4-way wire layout.

   d. Room temperature display.

   e. Weekly schedule.

2. Functions:
    a. Mode: Auto-Cool-Dry-Fan.
    b. Fan Speed: Auto-Low-Medium-High.
    c. Swing (on some models).
    d. Timer On/Off.
    e. Temperature setting.
    f. Weekly schedule.
    g. LCD display.
    h. Clock.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that space is ready to receive Work and opening dimensions are as instructed by the unit manufacturer.

B. Verify required utilities are available, in proper location, and ready for use.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Details of material and equipment installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

C. Provide minimum 6 inch clearances to adjacent construction in accordance with manufacturer's instructions, agency listings and applicable codes.

3.03 TESTING AND ADJUSTING

A. All equipment shall run at full capacity without undesirable swinging, undue vibration, or objectionable noise. All equipment shall deliver specified capacities and Contractor shall deliver to Engineer complete data sheets covering results of tests.

3.04 PROTECTION

A. Protect units with protective covers during balance of construction.

3.05 CLEANING

A. After construction is completed including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by manufacturer.

C. Install filter.

3.06 MOUNTING AND ATTACHMENT

A. The Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten all equipment and materials to be installed on or in concrete bases or structures which are existing or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 15760
TERMINAL HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to terminal heating and cooling units and control necessary for the completion of the Work in accordance with the Contract Documents.

B. Section included controls, control wiring, and control wiring conduit for HVAC equipment less than 115 volts. Power wiring, power electrical conduit, power distribution panels, and circuit breakers, for HVAC equipment 115 volts and greater is included in Division 16.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. All wall, roof, and floor penetrations for any building modifications which are required for the installation of the Work under this Section shall be provided by this Section. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.

E. Equipment with a suitable factory finish shall not be painted unless the finish is damaged or the color does not match that of adjacent equipment. If the finish is damaged or the color does not match, the equipment shall be field painted under this Section in accordance with the requirements of Section 09900.

F. Certain electrical starters, disconnects, and wiring will be provided and connected to the electric motors and equipment under Division 16. The Contractor shall refer to the Electrical Drawings and Specifications for Work included under Division 16. All control wiring shall be included in this Section and shall be installed as required in Division 16.

G. Concrete curbs and bases required for equipment specified herein will be provided under this Section and installed by procedures in Sections 03200, 03300, 03310, and as detailed on the Drawings.

H. Prefabricated roof curbs and prefabricated duct supports shall be furnished and installed under this Section. Flashing and roofing to be under Section 07800 and/or Section 07600.

I. Hangers, anchors, and supports provided by this Section shall be in accordance with Section 15010.

J. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

K. Provide and install all equipment specified within this Section. The Contractor shall perform all electrical installation for all voltages less than 115 volts.

L. All electrical work for all voltages, 115 volts and greater, shall be performed under Division 16, including but not limited to, motor operated dampers, motor operated valves, control panels, and line voltage thermostats provided by this Contractor.

M. Certain equipment furnished under this Section shall be connected to the plant control system by others as shown on the P&ID Drawings. Those connections and any remote control connections shall be clearly labeled terminal strips within the equipment control panel.

N. Additional product requirements are specified in Section 01350.

1.02 GENERAL SCOPE

A. Contractor to provide all labor, material, apparatus, expendable equipment, and all other services required for the construction of complete systems as outlined above, herein, and within the Drawings.

B. Although a portion of the equipment described herein and on the Drawings may be installed by others, this Contractor shall be responsible for coordinating the Work performed by others so that the system or systems described herein are complete and perform as intended.

C. The Drawings and Specifications are intended to describe the intent of the Work, and each are both complementary and independent in presenting the Work to be accomplished under this Contract.

1.03 PERMITS AND INSPECTION

A. The Contractor shall obtain all necessary permits including the HVAC Permit, shall have all Work inspected by the proper authorities, and shall furnish such certificates of inspection and test as are required by local, State, and Federal regulations. Cost of such permits and inspections shall be included in this Section.

1.04 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Descriptive information of all mechanical and electrical items used in providing a complete job.

   c. Drawings locating anchors, inserts, and supports.

d. Complete list of accessories and appurtenances included with each item, complete with manufacturer's name and model number.

e. General arrangement and dimension drawings.

f. Section assembly drawings.

g. Materials of construction.

h. Certified capacity data.

i. Schematic wiring diagrams and electrical load requirements.

j. Shop Drawings shall include data for all equipment, piping, and valves, controls, accessories, and electrical apparatus to be supplied with equipment.

2. Information for the Record:

a. (List material, installation, or calibration certificates)

b. (List any other information for the record)

c. Certified capacity data.

d. Operation and maintenance manual.

1.05 DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the Drawings shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

1.06 ELECTRICAL AND CONTROL COORDINATION

A. All equipment shall be powered electrically and wired as required in Division 16.

1.07 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All equipment and appurtenances shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed equipment from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any equipment damage after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the equipment cleaned and ready for use.

1.08 GENERAL REQUIREMENTS

A. Conform to applicable code for internal wiring of factory-wired equipment.

B. Heating units shall be UL listed and comply with the requirements of the National Electrical Code.

C. Fans shall be AMCA certified.

D. Contractor shall check electrical, architectural, and piping drawings for possible interferences and shall coordinate installation with other contractors.

E. Equipment shall be as indicated in the Specifications and on the Drawings.

F. Water coils shall be ARI certified.

G. Where noted, all coils shall be coated externally with a thermal setting, two coat, corrosive resistance to sulfides coating such as Liberty Plastics & Metals, Libcote-7, Heresite P-403 or equal. Coil to be completely degreased and free of paint and soft solder. Unit to be coated by a dip and baking operation and repeated for a 2-mil minimum thickness. Coating to reduce heat transfer rate by less than 5% with a thermal conductivity of 7000 Btuh/mil-SF. Application when finished must meet requirements of the USDA and FDA.

PART 2 PRODUCTS

2.01 RESERVED

2.02 PROPELLER HOT WATER UNIT HEATERS (UHW)

A. Hot water unit heaters shall be Trane Model UHSB, Airtherm Model HR, Dunham-Bush, or equal, standard horizontal discharge, propeller fan units. Units shall be provided with optional 4-way adjustable louvers.

B. Heaters shall be rated as shown in schedule on the drawing and based on 60 degrees F entering air, 200 degrees F entering water with 40 degrees F water temperature drop through unit.

C. Motors shall be direct drive, totally enclosed, 120/1/60, with automatic control from space thermostat.

2.03 RESERVED

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that space is ready to receive Work and opening dimensions are as instructed by the unit manufacturer.

B. Verify required utilities are available, in proper location, and ready for use.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Details of material and equipment installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

C. Terminal heating and cooling units shall be installed complete as shown on the Drawings and as specified.

D. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Provide hydronic units with shut-off valves on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan soil units, and unit heaters, provide float-operated, automatic air vents with stop valve.

F. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 Sections.

G. Connect hot water supply and return or steam supply and condensate return piping to coils and test for leaks.

3.03 TESTING AND ADJUSTING

A. When the terminal and heating cooling unit systems are complete and ready to be turned over and before final acceptance, Contractor shall run systems for the purpose of testing and adjusting. Air shall circulate freely and there shall be no evidence of leaks or air binding.

B. All equipment shall run at full capacity without undesirable singing, undue vibration, or objectionable noise. All equipment shall deliver specified capacities and Contractor shall deliver to Engineer complete data sheets covering results of tests.

3.04 PROTECTION

A. Protect units with protective covers during balance of construction.

3.05 CLEANING

A. After construction is completed including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by manufacturer.

C. Install new filters.

3.06 MOUNTING AND ATTACHMENT

A. The Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten all equipment and materials to be installed on or in concrete bases or structures which are existing or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15810
DUCTWORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing all materials, equipment, labor, and supervision related to HVAC ductwork systems necessary for the completion of the Work in accordance with the Contract Drawings.

B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

C. Additional product requirements are specified in Section 01350.

1.02 DESCRIPTION OF SYSTEMS AND MATERIAL

A. Systems shall be as shown on the Drawings.

B. Biofilter Building: Aluminum or Stainless Steel.

C. Odor Control Duct: FRP

1.03 DESIGN OF SYSTEM

A. The Contractor shall design the duct to meet the required operating pressure by means of duct material thickness, spacing of joints, and reinforcing and joint construction.

1.04 PERFORMANCE REQUIRMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Descriptive literature, bulletins, or other data describing each item of equipment.

c. Complete list of accessories and appurtenances included with each item complete with manufacturer's name and model number.

d. General arrangement and dimension drawings.

e. Sectional Assembly Drawings.

f. Materials of construction.

g. Submit sample of duct material, made up into an elbow with turning vanes.

h. Certified leak test as required by SMACNA HVAC Duct Leakage Test Manual.

2. Information for the Record:

a. Certified design capacity data for each section of duct.

3. Operation and maintenance manual.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with the latest edition as published by SMACNA – HVAC Duct Construction Standards – Metal and Flexible and SMACNA – Thermoplastic Duct (PVC) Construction Manual.

B. Construct ductwork to NFPA 90A standards.

1.07 DUCTWORK FABRICATON

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Use 45 degree entries for taps or tees. Construct tees, bends, and radius elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide single thickness turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gages heavier than the duct gages as indicated in SMACNA Standard. Joints shall be minimum 4 inches cemented slip joint, brazed or electric-welded. Prime-coat welded joints.

E. Provide standard 45 degree lateral wye take-offs unless otherwise indicated where 90 degree conical tee connections may be used.

F. Duct Inlet/Outlet Screens: Provide duct inlets or outlets with wire screen, constructed of the same material as the ductwork it is serving, 0.063 inch diameter (16 gage), 1/4 inch by 1/4 inch mesh (2 mesh).

1.08 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

PART 2 PRODUCTS

2.01 DUCTWORK GENERAL

A. Sheet Metal – Rectangular:

1. Ductwork, unless otherwise noted, shall be galvanized sheet metal, stainless steel, or aluminum and shall be built as required by HVAC Duct Construction Standards, Metal and Flexible, latest edition as published by SMACNA and diagrammatically shown on the Drawings.
2. Ductwork 18-inch width and over shall be cross-broken, or ribbed and stiffened, so that it will not “breathe,” rattle, vibrate, or sag.
3. Curved elbows shall have a throat radius equal to the duct width. Provide splitter or turning vane(s) in all elbows.
4. Square elbows shall have double-thickness turning vanes, unless single-thickness vanes are clearly identified on the Drawings.
5. Transitions in ductwork shall be made with a slope not exceeding 1 to 5, preferably 1 to 7.
6. Supply duct splits shall be provided with splitter damper and adjustable locking quadrant. Splitter blade shall be 1.5 times the smaller split width.
7. Supply duct takeoffs shall include an adjustable air-turning device equal to Carnes No. 1250 Variturn Model 2, 3, or 4 or equal.

B. Sheet Metal – Round:

1. Round sheet metal duct shall be constructed as required in HVAC Duct Construction Standards as published by SMACNA and referred to above. Low pressure duct may be shop fabricated, using good practice. Medium and high pressure duct shall be manufactured product by a firm regularly engaged in such work and with a catalog listing construction, weight, Specifications, and pressure losses. Flat oval shall be same as medium pressure duct above.
2. Round duct insulated internally shall be a product of a manufacturer engaged in such production and shall have an internal perforated liner equal to United Acoustic K-27.

3. Flat oval duct insulated internally shall be same as B. above. Flat oval duct may be used in place of round or rectangular duct, provided the insulation thickness specified, and diffuser neck shall be rectangular to match duct.

2.02 DUCT MATERIALS

A. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum connectors and bar stock; alloy 6061-T6; or of equivalent strength.

B. Stainless Steel Ducts: ASTM A240 or ASTM A666, Type 316.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36; steel, galvanized or compatible with duct material; threaded both ends, threaded one end, or continuously threaded.

2.03 RESERVED

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 FIBERGLASS REINFORCED PLASTIC DUCT (FRP)

A. Manufacturers: Peabody Spunstrand, Viron International, or equal.

B. Fiberglass reinforced plastic duct shall be used to convey and distribute air, backwash water, tank drainage, and miscellaneous services as shown on the Drawings.

C. Duct shall be filament wound rated at design pressures indicated. Minimum wall thickness shall be 0.125-inch for 2-inch through 20-inch diameter, 0.187-inch for 24-inch through 36-inch diameter, 0.250-inch for 42-inch through 60-inch diameter. Rectangular ductwork thickness shall be determined by substituting the long side dimension for the round equivalent diameter thickness. The grade shall be Type 1, Gard 2 RTRP polyester, Class E glass filaments, per ASTM D2310.

D. The resin used shall be selected to meet the exposures and temperatures of the air to be exhausted. Fillers other than those added for flame retardant when required, shall not be allowed. Fillers used for flame retardant shall not exceed 5% by weight.

E. Corrosion liner shall consist of the inner surface layer containing a 20-mil thick minimum surface veil saturated with polyester resin consisting of approximately 90% resin and 10% glass content by weight. The surface veil shall be overlapped a minimum of 1-inch.

F. The structural layer shall be filament wound of premium grade isophtalic polyester resin and glass as required for the specific working pressure, bedding conditions, and design conditions.

G. The exterior of pipe shall contain sufficient resin to insure a relatively smooth surface, free from exposed glass fibers or sharp projections, and shall contain an ultra-violet inhibiting agent.

H. Standard lengths shall be in accordance with the manufacturers published product data sheets. Wall thickness of the duct furnished shall not, at any joint be less than 87.5% of the nominal wall thickness specified when measured in accordance with ASTM D3567 Standard Method of Determining Dimensions of Reinforced Thermosetting Resin Pipe and Fittings.

I. The duct shall have sufficient strength to exhibit, without structural damage, a minimum pipe stiffness in accordance with AWWA C950 and ASTM D24112 for the pipe laying conditions as noted for the design conditions.

J. Duct manufactured with a composite structural wall containing siliceous sand or other granular fillers is not acceptable.

K. Fittings shall be similar to that for the ducting.

1. Bends shall either be formed over a removable mold or fabricated from straight duct with the following mitre segments:

a. Bends up to 30 degrees - 1 mitre/2 gore

b. 31 degrees to 60 degrees bend - 2 mitre/3 gore

c. 61 degrees to 90 degrees bend - 4 mitre/5 gore

2. Corrosion resistance and working pressure equal to that of the connecting duct.

L. Duct joints shall be the same material as the pipe and shall meet or exceed the hoop tensile and axial strength requirements of the duct.

M. Flanges shall be filament wound socket type or hand lay-up per NBS PS 1569.

N. Flange gaskets shall be suitable for 250 degrees F continuous piping and constructed of neoprene rubber.

O. Fiberglass volume control dampers shall be Moffit Corp. or equal with fiberglass shaft, neoprene blade seal, Buna-N O-ring shaft seal with silicon grease and polypropylene cover, manual hand gradient control, 3-inch undrilled flanges and 304 stainless steel hardware.

2.08 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible (Round Duct Construction Standards), and as indicated on the Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's. bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round or oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat weld joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.

1. Sealants, Mastics, and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

2. Do not provide sealing products not bearing UL approval markings.

2.09 AUXILIARY EQUIPMENT

A. Duct reinforcing and hangers shall be of the same material as the duct system.

B. Duct splitter dampers - Young Regulator Co., Barber Coleman, Carnes, Hart and Cooley, or equal.

C. Spiral duct - Young Regulator Co., United Sheet Metal Division, or equal.

D. Turning devices - Carnes, Barber Coleman, Hart and Cooley, or equal.

E. Turning devices and splitter damper hardware for fibrous glass duct - Duro Dyne Midwest, or equal.

F. Mastics and Sealers - Foster Products, HB Fuller Co., United McGill, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION OF DUCT SYSTEMS

A. Manufacture, install, seal, and insulate all ductwork as shown on the Drawings and as required in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

B. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

E. Use double nuts and lock washers on threaded rod supports.

F. For outdoor ductwork, protect ductwork, ductwork supports, linings and coverings from weather.

G. Exhaust Outlet Locations:

1. Minimum Distance from Property Lines: 3 feet.
2. Minimum Distance from Building Openings: 3 feet.
3. Minimum Distance from Outside Air Intakes: 10 feet.

H. Low pressure ductwork and fittings shall be made tight for minimum air leakage. Large or noisy leaks will not be accepted. Duct tape shall not be used to seal joints, to make transitions, or for any other reason except on the outside of wrapped insulation. Duct tape shall not be used on sheet metal.

I. All ductwork shall have all joints, seams, and laps sealed to Class "C" duct sealing requirements with mastic equal to Hardcast DT-5300 to ensure a completely airtight duct system.

J. All duct systems shall be at least 95% efficient in volumetric transfer. The Contractor shall demonstrate efficiency by testing.

K. Hangers for ductwork shall be in accordance with the SMACNA Standards, Plate Nos. 18 and 19, hanger for ducts and upper attachments. Hanger strap material and angles shall be galvanized. With bar joist and roof construction, use welded studs or C-clamp with retaining clip attached to the bar joist. In all cases, the maximum hanger spacing shall not be exceeded and the hangers shall be readily removable as required by SMACNA.

L. Ducts may be hung from the building construction by strap hangers fastened to the duct in not less than two places and rigidly braced against swaying. Do not fasten any hanger to metal roof decking. Strap material shall be aluminum, stainless steel, or galvanized in order to be compatible with the service requirements.

M. Where ducts pass through walls or floors, sheet metal closures shall be provided to close openings around ducts except where noted by specific detail. All passages shall be airtight to restrict air, moisture, and dust migration.

N. All ductwork exposed to weather shall have all joints, laps, edges, etc., sealed and coated with duct sealer equal to Hardcast DT-5300 and applied with FTO-20 adhesive or approved equivalent.

O. All ductwork exposed to weather and not insulated shall have all joints, laps, edges, etc., sealed and coated with duct sealer equal to Hardcast DT-5300 and applied with FTO-20 adhesive or approved equivalent.

3.03 INSTALLATION OF INSULATED FLEXIBLE DUCT

A. Connect air terminal units and air outlets and inlets to supply ducts with five foot maximum length of flexible duct. Do not use flexible duct to change direction. Flexible duct shall be limited in length to that necessary to make connections between trunk ducts and terminal units. This shall not exceed 5-feet.

B. All duct shall be fully stretched out to reduce resistance.

C. Connections to fittings or terminals shall be made with stainless steel bands, designed for that service. The inner liner shall be clamped tight with the band, then the insulation and jacket pulled up tight against the duct or terminal. Install a second band around the outside of the jacket. Installation shall be as recommended by the duct manufacturer.

D. Support the flexible duct by the hanger strip with support wires on 30-inch intervals to relieve strain on any fitting. Unnecessary bends, sags, twists, etc., will not be allowed.

3.04 INSTALLATION OF FRP DUCT

A. All duct shall be inspected upon delivery and all defective duct and fittings replaced.

B. Install all duct and fittings to the lines and grades shown on the drawings and in accordance with the manufacturer's instructions and applicable AWWA and ASTM standards for Recommended Practice for Underground Installation of Flexible Reinforced Thermosetting Resin Pipe and Reinforced Plastic Mortar Pipe.

C. At all-time during construction, keep duct and fittings clean, and close ends to prevent foreign materials from entering.

D. Provide suitable duct supports as specified, or in accordance with manufacturer's recommendations.

E. FRP duct shall not be used to support equipment. Independent support shall be used for all equipment.

3.05 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or by pass during cleaning. Install access openings into ductwork for cleaning purposes.

3.06 TESTING

A. Subject completed duct system to pressure and leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Test shall be completed after duct cleaning, but before duct insulation is applied or ductwork is concealed.

3.07 DUCTWORK PRESSURE CLASS

A. Design pressure required is 2-inch WC for all ductwork systems.

3.08 DUCTWORK SCHEDULE

A. Biofilter Building HVAC: Aluminum or Stainless Steel.

B. Odor Control Duct serving Bio-bed and carbon scrubbers: FRP

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 15820
DUCT ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to duct accessories necessary for the completion of the Work in accordance with the Contract Documents. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.

B. This Section shall include but not limited to all appurtenances required for complete installation.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

E. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Product Data: Provide manufacturer's data on duct accessories to include catalog information. Submit information that illustrates pressure drops for all sizes of dampers required at all anticipated air flow rates in accordance with AMCA Standard 500.

2. Information for the Record:

   a. Manufacturer's Installation Instructions: Submit for fire and combination smoke and fire dampers.

   b. Operation and maintenance manual. Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.03 QUALITY ASSURANCE

A. Dampers tested, rated and labeled in accordance with the latest UL requirements.

B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.04 DELIVERY, STORAGE. AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

C. Storage: Store materials in a dry area indoor, protected from damage.

D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect material and finishes during handling and installation to prevent damage.

1.05 ELECTRICAL AND CONTROL COORDINATION

A. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories, Inc., as suitable for the purpose specified and indicated.

1.06 SPARE PARTS

A. Provide two of each size and type of fusible link.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS

A. Stainless Steel:

1. Manufacturers: Ruskin Model S2SS, Arrow, or equal.
2. Construction:
    a. Frame: 2-inch depth, 16 gauge Type 304 stainless steel channel, with windstops all around.
    b. Blades: Single piece with bottom break and curled edges, parallel action, 26 gauge, Type 304 stainless steel.
    c. Bearings: Nylon.
    d. Linkage: In airstream.
    e. Axles: Full length, 0.1875 inch diameter stainless steel.
    f. Finish: Mill.

B. Aluminum:

1. Manufacturers: Ruskin Model BD2A2, Arrow, or equal.

2. Construction:

   a. Frame: 2-inch depth, minimum 0.090 inch 6063-T6 extruded aluminum channel with mitered corners, no flanges.

   b. Blades: Single piece, overlap frame, parallel action, minimum 0.050 inch 6063-T6 extruded aluminum, maximum 6-inch width.

   c. Bearings: Corrosion resistant, long life, synthetic, formed as single piece with axles.

   d. Blade Seals: Neoprene, mechanically attached to blade edge.

   e. Linkage: Concealed in frame.

   f. Axles: Corrosion-resistant, long life, synthetic, locked to blade and formed as single piece with bearings.

   g. Finish: Mill aluminum.

2.02 RESERVED

2.03 RESERVED

2.04 RESERVED

2.05 DUCT ACCESS DOORS

A. Stainless Steel:

1. Manufacturers: Ruskin Model ADH22, Ductmate Industries, Inc., Model FD1H, or equal.

2. Construction: Rigid and close fitting of Type 316 stainless steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover. Double wall type with 1 inch fiberglass insulation, hinge and cam locks. Access door size shall be maximum standard size to fit ductwork.

3. Frame: Minimum 22 gauge roll formed, stainless steel with installation tabs.

4. Door:

   a. Type: Hinged, double skin.

   b. Material: Minimum 22 gauge stainless steel.

5. Hinge: Continuous, piano-type.

6. Lock: Manually operated cam.

7. Insulation: Minimum 1-inch thick fiberglass.

8. Finish: Stainless steel.

B. Aluminum:

1. Manufacturers: Ruskin Model ADH22, Ductmate Industries, Inc., Model FD1H, or equal.
2. Construction: Rigid and close fitting of aluminum with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover. Double wall type with 1 inch fiberglass insulation, hinge and cam locks. Access door size shall be maximum standard size to fit ductwork.
3. Frame: Minimum 0.063-inch roll formed, aluminum with installation tabs.
4. Door:
   a. Type: Hinged, double skin.
   b. Material: Minimum 0.063-inch aluminum.
5. Hinge: Continuous, piano-type.
6. Lock: Manually operated cam.
7. Insulation: Minimum 1-inch thick fiberglass.
8. Finish: Mill aluminum.

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 VOLUME CONTROL DAMPERS

A. Stainless Steel:

1. Manufacturers: Ruskin Model CD-36CE, Arrow, or equal.
2. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.
3. Construction: Fabricate from Type 316L stainless steel, minimum 16 gauge frames and blades. Blades shall overlap when closed. Linkage shall be concealed in frame and out of airstream. Type 316 stainless steel oil impregnated blade bearings. All other components constructed of stainless steel.
4. Locking Quadrants: Stainless steel construction. Dampers shall include extended shafts and be capable of being locked in position for air balancing from the

exterior and not require further adjustment. File-mark shafts to permanently indicate damper blade position.

5. Dampers 12 inches and over in height shall be opposed blade type.

B. Aluminum:

1. Manufacturers: Ruskin Model CD-51, Arrow Type AFD-20, or equal.

2. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.

3. Construction: Fabricate from Type 6063-T5 aluminum, 0.08 inch thick extruded frames and blades. Blades shall overlap when closed. Linkage shall be concealed in frame and out of airstream. Molded synthetic blade bearings. Steel parts factory-coated with enamel.

4. Locking Quadrants: Dampers shall include extended shafts and be capable of being locked in position for air balancing from the exterior and not require further adjustment. File-mark shafts to permanently indicate damper blade position.

5. Dampers 12 inches and over in height shall be opposed blade type.

2.10 BUTTERFLY CONTOL DAMPERS

A. Manual Isolation Damper

1. Manufacture: Ruskin Series 914 Control Damper or Equal.

2. Conn: 36” or 46” FL constructed to PS 15-69 standards

3. Type: Butterfly, center pivoted

4. Max Operating Temp: 200°F

5. Max Operating Pressure: 30” w.c.

6. Class Leakage Rated: 1A or 3 cfm sq.ft. @ 1” w.g.

7. AMCA Certified

8. Material of construction: Frame/Blade - Vinyl Ester Fiberglass, Axle – Pultruded Vinyl Ester, Bearings – PTFE

1. Includes: Epoxy Coated Manual Hand Wheel Gear Operator

a. HWGO – Bray Series 4 Gear Operator or Equal

B. Automated Control Damper

1. Manufacture: Ruskin Series 914 Control Damper or Equal.

2. Conn: 36” or 46” FL constructed to PS 15-69 standards

3. Type: Butterfly, center pivoted

4. Max Operating Temp: 200°F
5. Max Operating Pressure: 30" w.c.
6. Class Leakage Rated: 1A or 3 cfm sq.ft. @ 1" w.g.
7. AMCA Certified
8. Certified for use in a Class I, Div2 environment
9. Material of construction: Frame/Blade – Vinyl Ester Fiberglass, Axle – Pultruded Vinyl Ester, Bearings – PTFE
10. Includes: Pre-mounted Electrical Actuator w/heater – Valvcon ADC Series Actuator or Bray 70 Series Actuator or Equal:
    a. - 115v electric actuator
    b. - 300lb-in Torque (to be verified)
    c. - Weather Tight & XP housing,
    d. - holding brake
    e. - Heater w/ Thermostat
    f. - two auxiliary switches (position).

2.11 RADIAL VANE CONTROL DAMPER

A. Automated Flow Control Damper

1. Manufacture: Ruskin Series 851FG Inlet Vane Damper or Equivalent,
2. Conn: 36" FL constructed to PS 15-69 standards
3. Type: Rotary Vane, open Hub w/Crank Lever for Motor Operation.
4. Max Operating Temp: 200°F
5. Max Operating Pressure: 30" w.c.
6. Certified for use in a Class I, Div2 environment
7. Material of construction: Frame/Blade - Vinyl Ester Fiberglass, Axle –Vinyl Ester Fiberglass Rod, Bearings – graphite impregnated PTFE, 316SS Crank Lever & linkage
8. Includes: Pre-mounted Electrical Actuator w/heater – Valvcon ADC Series Actuator or Bray Series 70 Actuator w/Servo NXT or Equal:
    a. - 115VAC electric actuator
    b. - input: 4-20mA
    c. - output: 4-20mA
    d. - 300lb-in Torque (to be verified)

e. - Weather Tight & XP housing,

f. - holding brake

g. - Modulating controller

h. - Heater w/ Thermostat

i. - two auxiliary switches (position).

2.12 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers: Ductmate Industries, Inc., Proflex, Duro Dyne, Metal Fab, or equal.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed, fire-retardant, neoprene-coated, woven glass fiber fabric to NFPA 90A, minimum density 30 ounces per square yard.

2. Net Fabric Width: Approximately 3 inches wide.

3. Metal: 3 inches wide.

a. 24 gauge Type 316L stainless steel.

b. 0.032 inch thick aluminum.

2.13 RESERVED

2.14 RESERVED

2.15 EXPANSION JOINTS

A. Manufacturer: Mason Industries/Mercer Rubber Model 501, Hyspan, or equal.

B. Construction: Heavy duty expansion joints shall be provided at the inlet and outlet connections of the blower and all equipment connecions. The joints shall be of the single arch style and designed for maximum temperature of 200 degrees F, pressure of 10 psig, and vibration that may result from operation of the system. The joint shall be 125 pounds ANSI flat face. A control unit shall be provided to limit the axial movement of the discharge expansion joint.

2.16 DUCT TEST HOLES

A. Plastic Plugs: Plastic, removable type, duct plugs, for duct test holes used for HVAC duct system air balancing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify rated walls are ready for fire damper installation.

B. Verify ducts and equipment installation are ready for accessories.

C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.02 INSTALLATION

A. Install in accordance with NFPA 9-A, and follow SMACNA HVAC Duct Construction Standards – Metal and Flexible. Refer to Section 15810 for duct construction and pressure class.

B. Details of ductwork accessories installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

C. Check location of ductwork accessories and make necessary adjustments in position to conform with architectural features and symmetry.

D. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on the Drawings.

E. Install access doors at the following locations:

1. Spaced every 50 feet of straight duct.
2. Upstream of each elbow.
3. Upstream of each reheat coil.
4. Before and after each duct mounted filter, coil, fan, and automatic control damper.
5. Before and after each fire, smoke, and combination fire and smoke dampers.
6. Downstream of each VAV box.

F. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access. Install 4 x 4 inch for volume control dampers only. Review locations prior to fabrication.

G. Install fire, smoke, and combination fire and smoke dampers with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, and hinges.

1. Install smoke and combination fire and smoke dampers in accordance with NFPA 92A.
2. Install dampers square and free from racking with blades running horizontally.

3. Do not compress or stretch damper frame into duct opening.

4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.

5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

H. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction.

I. Demonstrate re-setting of fire dampers to Owner's representative.

J. Provide duct test holes where indicated and required for testing and balancing procedures.

K. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized HVAC equipment, and supported by vibration isolators. For fans developing static pressures of 5.0 inches w.c. and over, cover connections with leaded vinyl sheet, held in place with metal strips.

L. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for balancing. Install minimum two duct widths from duct take-off.

M. Use splitter dampers only where indicated.

N. Provide balancing dampers on high velocity systems where indicated.

O. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

P. The Drawings show approximate location for ductwork accessories. Carefully check electrical and architectural drawings for proper placement of air outlets and inlets and be responsible for exact location and size of openings required.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 15830
FANS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing fans as shown and scheduled on the Drawings, and as specified herein.

B. The fans shall be furnished with all drives, belts, guards, support brackets, curbs, anchor bolts, vibration isolators, dampers, motor and temperature controls, and all other equipment as required and scheduled on the Drawings.

C. All Work performed under this Section shall comply with and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Additional product requirements are specified in Section 01350. Protect motors, shafts, and bearings from weather and construction dust.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

   c. Product Data: Submit data on each type of fan and include accessories, certified fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet rated capacity, electrical characteristics and connection requirements.

   d. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions literature.

2. Information for the Record:

   a. Certification that units are licensed to carry the AMCA "A" Seal.

3. Operation and Maintenance Data: Submit operation and maintenance manual that includes instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.03 MOTOR AND EQUIPMENT REQUIREMENTS - WIRING, CONDUIT, AND STARTER

A. All wiring, including factory prewired units, shall conform to NEC Standards.

B. Motors, controls, and disconnects shall be furnished as required and scheduled on the Drawings.

C. All fans and motors required for explosion hazard areas shall be shipped prewired from the factory or shall be able to be connected in the field as required by the National Electrical Code for the NEMA class specified.

1.04 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, an tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

1.05 EXTRA MATERIALS

A. Furnish two spare sets of belts for each type fan.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Fan motor starters and wiring to fan motor and damper operators, including interlocks shall be installed as required under the Division 16.

B. Roof curbs shall be furnished by the fan manufacturer and specified in this section.

C. Vibration isolators shall be provided for all supports.

D. Provide duct companion flanges for round duct connections to the unit. Provide back-draft dampers of the gravity type for units discharging to the outside or against any pressure from other sources.

E. Units in exposed locations shall be provided with weather protection.

F. Motors required for explosion hazard areas shall meet Class 1, Division 1, Group D classification as required per the NEC.

G. All fans required for explosion hazard areas shall meet AMCA 99-0401-66, Type A construction.

2.02 FANS GENERAL

A. Fans shall be as indicated in the HVAC equipment schedules on the drawings as manufactured by Loren Cook, Penn, Greenheck, or Owner approved alternate.

2.03 RESERVED

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

2.08 VANEAXIAL INLINE FANS

A. Manufacturers: Loren Cook Model CVB, Penn, Greenheck, or equal.

B. Fan Unit: V-belt or direct driven, spun aluminum, duct mounted, mixed-flow fan. Bolted and welded construction utilizing corrosion resistant fasteners. Spun aluminum housing constructed of minimum 0.125 inch thick marine alloy aluminum with inlet and outlet flanges with straightening vanes for uniform airflow. Provided with extended lube lines for lubrication of fan bearings. Adjustable aluminum motor mounting plate with threaded studs for positive belt tensioning with extruded rubber isolation between bracket and fan housing.

C. Fan Wheel: Non-overloading design utilizing airfoil blades for maximum efficiency. Aluminum airfoil blades shall be welded to a spun aluminum dome. Dome bolted to an aluminum hub assembly. Hub keyed and locked to the fan shaft utilizing set screws. Wheel shall be statically and dynamically balanced.

D. Electrical Characteristics and Components:

1. Motor: Follow NEMA MG1. Provide built-in overload protection for single-phase fractional horsepower motors. Explosion proof motors with construction conforming to Class I, Divisions 1 and 2, Group D of the National Electrical Code.

2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

3. Disconnect Switch: Provide integral mounted and pre-wired NEMA 7 disconnect switch.

E. Bearings: Heavy duty regreasable ball type construction, cast iron housing selected for minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

F. Belts and Drives: Oil and heat resistant, static conducting belts. Precision machined cast iron type drives, keyed and securely attached to the wheel and motor shafts. Provide with a belt guard.

G. Accessories:

1. Companion flanges.

2. Flexible Duct Connectors: Aluminum band construction with reinforced neoprene construction.

3. Vibration Isolators: Rubber in shear type for ceiling mounting.

H. Finish: Electrostatically applied, baked epoxy powder coating. Coating must be resistant to hydrogen sulfide.

2.09 RESERVED

2.10 RESERVED

2.11 RESERVED

2.12 RESERVED

2.13 RESERVED

2.14 RESERVED

2.15 RESERVED

2.16 FIBERGLASS AXIAL FLOW FANS

A. Chlorine fan shall be wall mount or duct mount axial flow, centrifugal fan constructed of fiberglass such that it will resist effects of chorine gases. MK Plastics, Chicago Fan, Glendale Heights, Illinois, Moffit Corp., Jacksonville, Florida, Aerovent, Piqua, Ohio, or equal.

1. Housing and impeller shall be constructed of chlorine gas resistant fiberglass.

2. Motor shall be TEFC and placed out of the air stream.

3. Bearings shall be lubricated, self-aligning ball bearings with a L10 bearing life of 100,000 hours. Fittings shall be extended when covered.

4. Belts, when equipped, shall be non-static, multiple banded, oil resistent and selected for two times the fan brake horsepower, and shall be Woods Ultra-V V8, or equal. Provide OSHA approved belt guard.

5. Pulleys shall be cast iron with adjustable driver for balancing at the job site.
6. Unit shall be supplied with gravity operated fiberglass louver.

2.17 RESERVED

2.18 RESERVED

2.19 RESERVED

2.20 RESERVED

2.21 RESERVED

2.22 RESERVED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.02 INSTALLATION

A. Fans shall be installed as recommended by the manufacturer using the proper supports and isolators for quiet operation.

B. Proper rotation of the fan shall be verified.

C. Belts or speed control shall be adjusted to provide the design system air quantity at the system static pressure.

D. The current draw shall be measured and compared to the nameplate current shown.

E. The installation is not complete until the system has been balanced to provide the correct air quantity and has been tested to demonstrate the correct system performance. See Testing, Adjusting and Balancing, Section 15990.

F. Secure roof and wall exhausters with stainless steel lag screws to roof curb or structure.

G. Install flexible connections between inlet and outlet of fans to ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

H. Provide sheaves required for final air balance.

I. Install backdraft dampers on inlet to wall exhausters and in the roof curbs of roof exhausters.

J. Provide backdraft dampers on outlet from cabinet and ceiling fans and as indicated on the Drawings.

K. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test-run under observation.

L. At rough openings in walls for fans, provide sheet metal escutcheon to close opening around fan plenums.

M. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

N. Extend ducts to wall exhausters through wall structure. Counterflash duct to wall opening.

O. Install safety screen where inlet or outlet is exposed.

P. Install backdraft dampers on discharge of exhaust fans.

Q. Pipe scroll drains to nearest floor drain.

3.03 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for a minimum of one day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15850
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SCOPE

A. Section Includes:

1. Registers.

2. Grilles.

B. This Section includes furnishing all materials, equipment, labor, and supervision related to air outlets and inlets necessary for the completion of the Work in accordance with the Contract Documents. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.

C. This Section shall include but not limited to all appurtenances required for complete installation.

D. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

E. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

F. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

b. Provide manufacturer's product data including materials of construction, type of mounting, finish, and airflow capacity tables showing size, airflow, static pressure drop, and sound rating information at rated capacity.

2. Information for the Record:

a. Operation and maintenance manual. Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.03 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

1.04 DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the Drawings shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

1.05 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All air outlets and inlets shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed air outlets and inlets from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any air outlets and inlets damaged after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the air outlets and inlets cleaned and ready for use.

1.06 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE Standard 70.

B. Perform Work in accordance with applicable codes and standards.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 SUPPLY REGISTERS

A. Manufacturers: Titus Model 350FS, Anemostat, Price, or equal.

B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, with front blades parallel to short dimension.

C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Aluminum extruded frames/borders with 22 gage aluminum airfoil blades construction with baked enamel off-white finish.

E. Damper: Integral, gang-operated, aluminum opposed blade damper type with removable key operator, operable from face.

2.02 EXHAUST/RETURN GRILLES

A. Manufacturers: Titus Model 50F, Anemostat, Price, or equal.

B. Type: Fixed grilles of 1/2 by 1/2 by 1/2 inch eggcrate type grid.

C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Aluminum extruded frames/borders with aluminum eggcrate grid construction with baked enamel off-white finish.

E. Damper: Integral, gang-operated, aluminum opposed blade type damper with removable key operator, operable from face.

2.03 RESERVED

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify inlet and outlet locations.

B. Verify that ceiling, walls, and ductwork systems are ready for installation.

3.02 INSTALLATION

A. Details of air outlets and inlets installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

B. Check location of air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangements.

C. Install diffusers to ductwork with airtight connections.

D. Provide and install balancing dampers on duct take-off to diffusers, registers, and grilles, despite whether dampers are part of the diffuser, register, or grille assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. The Drawings show approximate location for air outlets and inlets. Carefully check electrical and architectural drawings for proper placement of air outlets and inlets and be responsible for exact location and size of openings required.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 15855
LOUVERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to intake and exhaust louvers necessary for the completion of the Work in accordance with the Contract Documents. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.

B. This Section shall include but not limited to all appurtenances required for complete installation.

C. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.

E. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Provide manufacturer's data on louvers to include the following information: free area chart/table, static pressure loss, air leakage, and water penetration data.

   c. Provide and submit catalog information on louver motor operators.

   d. Provide and submit a color and finish chart.

2. Information for the Record:

   a. Operation and maintenance manual. Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.03 QUALITY ASSURANCE

A. Test and rate louver performance in accordance with AMCA 500.

1.04 DRAWINGS

A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the Drawings shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

1.05 PROTECTION FROM DAMAGE

A. Delivery, Handling, and Storage:

1. Material delivery, handling, and storage shall meet the requirements of Section 01350.

2. All louvers shall be accepted on site in factory packaging. Inspect for damage.

B. After Installation:

1. Protect installed louvers from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. Suitable covers shall be placed to protect against any louver damaged after it is installed and during the final days of construction.

3. Before acceptance, all covers and protective material shall be removed and the louvers cleaned and ready for use.

PART 2 PRODUCTS

2.01 LOUVERS – GENERAL

A. Free areas of louvers shall be sufficient for intended airflows without water penetration.

B. Construct louvers which exceed manufacturer's instructed width or height in multiple sections, connected by hidden mullions. Fabricate mullions of same material as louver with same finish.

C. Provide extended sills and stools for ease in mounting where indicated on Drawings.

D. Bird Screens: Minimum 0.040 inch aluminum wire, 1/2-5/8 inch square mesh mounted in removable aluminum frames.

E. Insect Screens: 18-16 mesh, 0.011 inch aluminum wire mounted in aluminum frames. Louver design shall allow screens to be removable and mounted on the face of louvers without interfering with louver, damper, and drive function.

F. Extended Sills: Extruded 6063-T6 aluminum alloy, minimum nominal wall thickness of 0.060 inch.

G. Finish: Minimum 1.5 mil thick baked-on acrylic enamel. Minimum 0.7 mil clear anodized. Kynar or Hylar fluoropolymer, minimum 1.2 mils dry film thickness conforming to AA-

C12C4421x and AAMA 605.2 or other corrosion-resistant finish appropriate for installation conditions.

H. Provide finish on entire louver and birdscreen.

I. Color: Selected by Owner from manufacturer's standard colors.

2.02 RESERVED

2.03 STATIONARY LOUVERS

A. Manufacturers: Ruskin Model ELF6375DXH (6 Inch), Greenheck, Arrow, Airolite, or equal.

B. Description: Unit consists of drainable stationary blade.

C. Construction: 6 inch frame depth, extruded 6063-T6 aluminum alloy frame and blades, 0.125 inch frame and blade wall thickness.

D. Rating: AMCA rated at zero water penetration with the specified airflows and for air leakage of less than 4.0 cfm per square foot of face area at a wind velocity of 30 mph (0.44 inch w.c. pressure) with damper blades closed.

2.04 RESERVED

PART 3 EXECUTION

3.01 INSTALLATION

A. Details louvers installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

B. Check location of louvers and make necessary adjustments in position to conform with architectural features.

C. At rough openings in walls for louvers, provide sheet metal escutcheon to close opening around open louver plenums.

D. Install louvers plumb, level, in plane of wall, and alignment with adjacent work. Provide supporting structure and joint sealant as required.

E. The Drawings show approximate location for louvers. Carefully check all other discipline drawings for proper placement of louvers and be responsible for exact location and size of openings required.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 15950
TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision to test, adjust, and balance all heating, ventilating, air conditioning, and foul air conveyance systems necessary for the completion of the Work in accordance with the Contract Documents.

B. Work Included:

1. Testing, adjusting, and balancing of air systems.
2. Testing, adjusting, and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Vibration measurement of equipment operating conditions.

1.02 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 – National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers:

1. ASHRAE 111 – Practices for Measurement Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. Testing, Adjusting and Balancing Bureau:

1. TABB – International Standards for Environmental Systems Balance.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300.

B. Test reports shall indicate data on forms prepared by one of the following:

1. AABC MN-1.
2. ASHRAE 111.

3. NEBB.

4. TABB.

C. Field reports shall indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment tom achieve specified performance.

D. Submit draft copies of report for review prior to final acceptance of Project.

E. Furnish final reports in soft cover, letter size, binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.

1. Include diagrams of systems and equipment including balancing devices and dampers with pressure drops at each location.

2. Include both initial and final pressure drops and flows.

3. Indicate data on standard forms as listed above.

4. Completeness and accuracy of reports shall be certified by a principle of the balancing agency, who is not affiliated with any firm involved in the construction Project.

5. Submit data sheets on each item of testing equipment utilized. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

6. Record actual locations of flow measuring stations, balancing valves and their rough settings.

1.04 QUALITY ASSURNACE

A. All Work performed under this Section shall comply and be in accordance with the following:

1. All approved trade practices and manufacturer's recommendations.

2. AABC, ASHRAE 111, and NEBB.

1.05 QUALIFICATIONS

A. General:

1. Engage the services of an independent agency specializing in the testing, adjusting, and balancing of systems specified in this Section, hereinafter called the Balancing Subcontractor. The agency shall be acceptable to Owner and Engineer.

2. The agency selected shall be a fully certified member of the Associated Air Balance Council (AABC) and perform work under supervision of the following:

a. AABC Certified Test and Balance Engineer.

b. NEBB Certified Testing, Balancing, and Adjusting Supervisor or TABB Certified Supervisor.

c. Registered Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located.

3. All testing, adjusting, and balancing of HVAC systems shall be performed in complete accordance with the AABC "Standards and Instrumentations Form No. 81226, Volume I" as published by the AABC, including all current revisions thereto and/or ANSI/ASHRAE 110.

B. Workmanship:

1. All Work shall be done by technicians skilled in the particular field involved under the direct supervision of a Registered Professional Engineer and with the best modern practices and equipment.

2. All instruments used for measurement shall be accurate and calibration for each instrument shall be available for examination. The Engineer may request instrument recalibration, or the use of other instruments, where accuracy of readings is questionable.

3. The Balancing Subcontractor shall consult all drawings, construction details, job site, and confer and cooperate with others to avoid interference.

4. The Balancing Subcontractor shall check all control interlocks and cooperate with the control Subcontractor in adjusting and calibration of control equipment.

5. Any ceiling tile that is damaged by the Balancing Subcontractor shall be replaced with new tile identical to that damaged.

1.06 RESPONSIBILITY FOR PROPER BALANCING AND TESTING

A. The final testing, adjusting, and balancing and the test and balance data shall be witnessed by the Engineer's Project Representative if required by the Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 EVALUATION OF SYSTEM AND EXAMINATION

A. The Balancing Subcontractor shall furnish all materials and equipment necessary to properly measure the air capacity of the system, the electrical voltage and current, fan speeds, static pressures, air velocity, water pressure drops, refrigeration pressures, and

all other readings normally necessary to evaluate the performance of a system, adjust the quantities to those called for, and test the system.

B. Verify that all systems are complete and operable before commencing Work. Verify the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for the electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Volume control dampers are in place and operating.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets and inlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.02 BALANCE REQUIREMENTS

A. Balance equipment and systems per the information provided in the HVAC schedules, plan views, air flow schematics, or sequence of operations as shown on the Drawings.

3.03 CONTROL SEQUENCE

A. All control sequencing electrical interlocking shall be tested and verified. This Work shall be accomplished with a representative of the heating, ventilating, and air conditioning Contractor and temperature control Contractor present and assisting.

3.04 COMPONENT IDENTIFICATION

A. The Contractor is responsible for the identification of the equipment.

3.05 TESTING ACCESSES

A. The Contractor shall provide and/or arrange for all labor and material such as valves, tap holes, and plugs in the location required to perform the Work.

3.06 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets:

1. Adjust total to within plus 10 percent and minus 5 percent of design of space.

2. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.07 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.08 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, outside, and exhaust air quantities.

B. Make air flow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from minimal objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, and exhaust dampers to check leakage.

J. Measure temperature conditions across outside air, and exhaust dampers for design conditions.

K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply and exhaust systems to obtain required relationship between each to maintain approximately 0.05 inches differential static pressure between spaces.

3.09 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Confirm air bleeds indicate system is full of hydronic fluid.

D. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

E. Perform system balance with automatic control valves fully open, triple duty/multi-purpose valves fully open, and pump VFDs at 100 percent speed.

F. Confirm pump rotation and differential pressure at full flow.

G. Perform adjustment of water distribution systems by the following measures:

1. Reduce total system flow rate first by reducing speed of VFD.

2. Use balancing cocks, valves, and fittings.

H. Do not service or shut-off valves for balancing unless designed for balancing and shut-off functions. Where available pump capacity is less than total flow requirements or individual system parts, stimulate full flow in one part by temporary restriction of flow to other parts.

3.10 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

1. Plumbing Pumps.
2. Boiler Feedwater Pumps.
3. HVAC Pumps.
4. Water Tube Boilers.
5. Split System Air Conditioning Units.
6. Terminal Heat Transfer Unis.
7. Fan Coil Units.
8. Air Handling Units.
9. Fans.
10. Air Filters.
11. Air Inlets and Outlets.

B. Report Forms:

1. Title Page:
    a. Name of Testing, adjusting, and Balancing.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project Architect.
    g. Project Engineer.
    h. Project Contractor.
    i. Project altitude.
    j. Report date.
2. Summary Comments:
    a. Design versus final performance.
    b. Notable characteristics of system.
    c. Description of systems operation sequence.

d. Summary of outdoor and exhaust flows to indicate building pressurization.

e. Nomenclature used throughout report.

f. Test conditions.

3. Instrument List:

a. Instrument.

b. Manufacturer.

c. Model number.

d. Serial number.

e. Range.

f. Calibration.

4. Electric Motors:

a. Manufacturer.

b. Model/Frame.

c. HP/BHP and kW.

d. Phase, voltage, amperage; nameplate, actual, no load.

e. RPM.

f. Service factor.

g. Starter size, rating, heater elements.

h. Sheave Make/Size/Bore.

5. V-Belt Drive:

a. Identification/location.

b. Required driven RPM.

c. Driven sheave, diameter and RPM.

d. Belt, size and quantity.

e. Motor sheave diameter and RPM.

f. Center to center distance, maximum, minimum, and actual.

6. Pump Data:

a. Identification/number.

b. Manufacturer.

c. Size/model.

d. Impeller.

e. Service.

f. Design flow rate, pressure drop, BHP and kW.

g. Actual flow rate, pressure drop, BHP and kW.

h. Discharge pressure.

i. Suction Pressure.

j. Total operating head pressure.

k. Shut off, discharge and suction pressures.

l. Shut off, total head pressure.

7. Combustion Test:

a. Manufacturer.

b. Model number.

c. Serial number.

d. Firing rate.

e. Overfire draft.

f. Gas meter timing dial size.

g. Gas meter time per revolution.

h. Gas pressure at meter location.

i. Gas flow rate.

j. Heat input.

k. Burner manifold gas pressure.

l. Percent carbon monoxide (CO).

m. Percent carbon dioxide (CO2).

n. Percent oxygen (O2).

o. Percent excess air.

p. Flue gas temperature at outlet.

q. Ambient temperature.

r. Net stack temperature.

s. Percent stack loss.

t. Percent combustion efficiency.

u. Heat output.

8. Heating Coil Data:
    a. Identification/number.
    b. Location.
    c. Service.
    d. Manufacturer.
    e. Air flow, design and actual.
    f. Water flow, design and actual.
    g. Water pressure drop, design and actual.
    h. Entering water temperature, design and actual.
    i. Leaving water temperature, design and actual.
    j. Entering air temperature, design and actual.
    k. Leaving air temperature, design and actual.
    l. Air pressure drop, design and actual.
9. Air Moving Equipment:
    a. Identification/number.
    b. Location.
    c. Manufacturer.
    d. Model number.
    e. Serial number.
    f. Arrangement/Class/Discharge.
    g. Air flow, specified and actual.
    h. Return air flow, specified actual.
    i. Outside air flow, specified and actual.
    j. Total static pressure (total external), specified and actual.
    k. Inlet pressure.
    l. Discharge pressure.
    m. Sheave Make/Size/Bore.
    n. Number of Belts/Make/Size.
    o. Fan RPM.
10. Outside Air Data:
    a. Identification/location.

b. Design air flow.

c. Actual air flow.

d. Design return air flow.

e. Actual return air flow.

f. Design outside air flow.

g. Actual outside air flow.

h. Return air temperature.

i. Outside air temperature.

j. Required mixed air temperature.

k. Actual mixed air temperature.

l. Design outside/return air ratio.

m. Actual outside/return air ratio.

11. Fan Data:

a. Identification/number.

b. Location.

c. Manufacturer.

d. Model number.

e. Serial number.

f. Air flow, specified and actual.

g. Total static pressure (total external), specified and actual.

h. Inlet pressure.

i. Discharge pressure.

j. Sheave Make/Size/Bore.

k. Number of Belts/Make/Size.

l. Fan RPM.

12. Duct Traverse:

a. System zone/branch.

b. Duct size.

c. Area.

d. Design velocity.

e. Design air flow.

f. Test velocity.

g. Test air flow.

h. Duct static pressure.

i. Air temperature.

j. Air correction factor.

13. Duct Leak Test:

a. Description of ductwork under test.

b. Duct design operating pressure.

c. Duct design test static pressure.

d. Duct capacity, air flow.

e. Maximum allowable leakage duct capacity times leak factor.

f. Test apparatus:

1) Blower.

2) Orifice, tube size.

3) Orifice size.

4) Calibrated.

g. Test static pressure.

h. Test orifice differential pressure.

i. Leakage.

14. Terminal Unit Data:

a. Identification/number.

b. Location.

c. Manufacturer.

d. Model number.

e. Type, constant, variable, single, dual duct.

f. Size.

g. Minimum static pressure.

h. Minimum design air flow.

i. Maximum design air flow.

j. Maximum actual air flow.

k. Inlet static pressure.

15. Air Distribution Test Sheet:
    a. Air terminal number.
    b. Room number/location.
    c. Terminal type.
    d. Terminal size.
    e. Area factor.
    f. Design velocity.
    g. Design air flow.
    h. Test (final) velocity.
    i. Test (final) air flow.
    j. Percent of design air flow.

PART 4 SPECIAL PROVISIONS

4.01 MISCELLANEOUS TESTS

A. The Balancing Subcontractor shall perform building pressure tests with outside temperature and wind velocity noted at points of typical location inside building on both lee and windward side of building. Tests to be made with all supply and exhaust systems in normal operation and with supply systems at minimum outside air at approximately nominal wind velocity outside.

B. The Balancing Subcontractor shall perform air curtain tests for all fume hoods as noted below. Tests are to be conducted per ANSI/ASHRAE 110.

END OF SECTION

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SECTION 15980
HVAC CONTROLS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision to HVAC controls necessary for the completion of the Work in accordance with the Contract Documents.

B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

1.02 SECTION INCLUDES

A. Thermostats.

B. Freeze-stats.

C. Smoke detectors.

D. Differential pressure sensing controls.

E. Pilot lights and devices.

F. Control panels.

G. Miscellaneous accessories

1.03 SUBMITTALS

A. Provide description and engineering data for each control system component. Include sizing as requested. Provide data and wiring diagram for each system component and software module.

B. Indicate complete operating data, system drawings, wiring diagrams, control panel layout, ladder diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities and static pressure drops for each system.

1.04 QUALITY ASSURANCE

A. Install HVAC controls under the direct supervision of a licensed Temperature Controls Contractor.

1.05 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.06 COORDINATION

A. Follow the HVAC control sequence of operations as indicated in the HVAC drawings.

PART 2 PRODUCTS

2.01 THERMOSTATS AND SENSING ELEMENTS

A. Thermostats:

1. Hydronic Unit Heater Thermostats:

a. Manufacturers: Honeywell T651, or approved equal.

b. Enclosure with temperature scale indication and adjustable temperature control with a minimum range of 44 to 86 degrees F, line voltage type rated for 15 amperes at 120 volts.

2. Freeze-Stats:

a. Manufacturers: Honeywell L408B, or approved equal.

b. Minimum temperature range of 34 to 60 degrees F, 1/8 inch outside diameter 20 foot length sensing element and automatic reset.

3. Remote Bulb Thermostats:

a. Manufacturers: Honeywell T675, or approved equal.

b. Thermostat with remote liquid-filled sensing probe, 6 foot capillary tube, controller and mounting plate.

c. Adjustable Range: 0 to 100 degrees F.

d. Accessories: Duct or bulb mounting kit. For exterior bulb locations, provide with sun shield.

4. Proportional Remote Bulb Thermostats:

a. Manufacturers: Honeywell T991, or approved equal.

b. Thermostat with remote liquid-filled sensing probe, 6 foot capillary tube, proportional controller and mounting plate.

c. Adjustable Range: 0 to 100 degrees F.

d. Accessories: Duct or bulb mounting kit. For exterior bulb locations, provide with sun shield.

2.02 DUCT MOUNTED SMOKE DETECTORS:

A. Smoke Detector:

1. Manufacturers: Provide products of the following; Invensys Model L-302-2, System Sensor Model Innovair, Air Products and Controls Model SL-2000, Honeywell, or approved equal.

a. Smoke detectors shall be NFPA 72, ionization type with the following features.

b. 4-Wire type detector with common power supply and signal circuits.

c. Auxiliary relay contacts for both fan control and annunciation of remote alarm.

d. Key-operated normal-reset-test switch.

e. Duct sampling tubes extending width of duct.

f. Visual indication of detector actuation.

g. Duct-mounted housing.

h. Removable filters.

i. Electrical 120 VAC.

2.03 DIFFERENTIAL PRESSURE SENSING CONTROLS

A. Differential Pressure Sensor:

1. Manufacturers: Honeywell TDIAP502730, or approved equal.

a. General: Provide differential pressure sensing controls for positive proof of “Run” or “No Run” condition and dirty filter detection.

b. Rating: 24 VAC and capable of handling up to 12 inch w.c. pressure.

c. Accessories: Provide 1/4 inch tubing and 1/4 inch static pressure tips with differential pressure switches.

2.04 PILOT LIGHTS AND DEVICES

A. Manufacturers: Honeywell, or approved equal.

B. Monitoring Lights: Heavy duty, oil-tight, push-to-test type.

C. Control devices compatible with specified controls and capable or resetting at the control panel.

2.05 CONTROL PANELS

A. Construction: Per NEMA Standard 250 Enclosures for Electrical Equipment (1000 Volts Maximum).

B. General: Enclose controls in their respective equipment control panel, or in a remote, wall-mounted control panel. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons, and switches flush on cabinet panel face.

C. Panel: NEMA Type 1 rated.

D. Provide common keying for all panels.

2.06 CONTROL VALVES

A. Globe Pattern:

1. Manufacturers: Honeywell, or approved equal.
2. Up to 2 Inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
3. Over 2 Inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat, and disc.
4. Hydronic Systems:
    a. Rate for service of 125 psig at 250 degrees F.
    b. Replaceable plugs and seats of stainless steel or brass.
    c. Size for 3 psig maximum pressure drop at design flow rate.
    d. Two-way valves shall have equal percentage characteristics; three-way valves, linear characteristics. Size two-way valve operators to close valves against pump shut-off head.

B. Electric Operators:

1. Manufacturers: Honeywell, or approved equal.
2. Modulating or two-position as required for each service.
3. Valves: Spring return to normal position as indicated on freeze, fire, or temperature protection.
4. Select operator for full shut off at maximum pump differential pressure.
5. Electric-immersed, gear train type.

2.07 DAMPER OPERATORS

A. Manufacturers: Honeywell, or approved equal.

B. general: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than the maximum design velocity and to provide tight seal against maximum system pressures. Provide spring-return for two-position control and for failsafe operation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that systems are ready to receive Work.

3.02 PREPARATION

A. Sequence Work to ensure installation of components is complimentary to installation of similar components in other systems.

B. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.03 INSTALLTION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate 60 inches above finished floor.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide separable sockets for liquids and flanges for air bulb elements.

F. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

G. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same Equipment Room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

H. Install "Hand-Off-Auto" selector switches to override automatic interlock controls when switch is in "Hand" position.

I. Provide conduit and electrical wiring in accordance with Division 16 specifications sections. Electrical material and installation shall be in accordance with appropriate requirements of Division 16.

J. After installation, verify the complete operation of each system using the operation description submitted in the Shop Drawings and as described herein to the satisfaction of the Owner.

3.04 MANUFACTURER'S START-UP SERVICES

A. Provide for a minimum of one 4-hour day.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 16010
GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes general administrative and procedural requirements in accordance with the Drawings and as specified herein.

B. The Contractor shall furnish and install all wire, conduit, disconnects, and related items, for HVAC equipment 120 volts or greater under Division 16. Controls, control wiring, and control conduit for HVAC equipment less than 120 volts shall be furnished and installed under Division 15.

C. Wires, cable, equipment, and instruments shall be furnished and installed under Division 16 unless specified otherwise in Part 4.

D. The responsibility for the following equipment items and Work shall be as listed below:

1. Motors, unless indicated otherwise, shall be furnished and installed under other sections, but shall be wired as indicated on the Drawings under Division 16.

2. Controls for motors on mechanical equipment unless indicated otherwise, will be furnished under other sections, but shall be installed and wired under Division 16.

3. Unless otherwise indicated, all electrical and control equipment not furnished under Division 16 shall be installed and wired under Division 16.

4. Electrical and control equipment furnished under Division 16 but which is to be installed under other sections, shall be wired under Division 16 as indicated on the Drawings and Specifications.

1.02 SUBMITTALS

A. Specific submittals will be identified in individual sections of Division 16.

1.03 QUALITY ASSURANCE

A. Work shall comply with the latest edition of NEC as prepared by NFPA, NESC.

B. Contractor shall comply with applicable local electrical code requirements, where provisions of local codes are modified or supplemented with NEC, the more stringent interpretation shall prevail.

C. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

D. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

E. Equipment, materials, and installation shall comply with applicable requirements of NEMA, IEEE, and ANSI.

F. All electrical equipment shall be listed and labeled by UL.

G. Electrical enclosure requirements shall conform with area classifications, whether designated on the Drawings or not.

H. Contractor shall provide Owner with all certificates of final inspection from the agency of proper authority prior to receiving final payment.

1.04 ELECTRICAL CONTROL AND COORDINATION

A. Installation of electrical equipment shall be scheduled, sequenced, and positioned to efficiently coordinate the best flow of Work for electrical systems and all other non-electrical construction activities.

1.05 PRODUCT HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. A copy of these instructions shall be included with the equipment at the time of shipping.

B. Equipment damaged in shipment or storage shall not be installed and shall be replaced by the Contractor.

1.06 GUARANTEE

A. Provide complete warranty information for each item. Include the following information:

1. Date of beginning warranty period.
2. Duration of warranty.
3. Warranty options.
4. Name, address, phone numbers, and procedures for filing warranty claims.

B. The Contractor shall warrant the completed system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of substantial completion.

PART 2 PRODUCTS

2.01 NEMA RATINGS

A. Equipment and panels shall be NEMA 4X stainless steel unless designated otherwise on the Drawings, or in the electrical or equipment specifications.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate electrical system, equipment, and materials installations with other building components and building trades.

B. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, or starter for that motor or equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items under the section the equipment is specified. The increased wiring, conduit, and starter cost shall be included in the motor or equipment cost under the section the equipment is specified and no additional compensation will be allowed.

C. Certain equipment furnished under the equipment sections shall be connected to the plant control system as shown on the P&ID drawings. Mechanical and electrical components for these connections shall be furnished, under the equipment sections, as required to provide control functions compatible with the plant control system. These connections and any remote-control connections shall be furnished and wired to clearly labeled terminal strips within the equipment control panel.

D. If the electrical control requirements change from that specified or shown on the Electrical or P&ID drawings due to the requirements of the actual equipment furnished, the Contractor shall perform all necessary modifications under the equipment section and no additional compensation will be allowed. The final installation shall meet the operational intent of that specified and shown on the drawings.

3.02 INSTALLATION

A. Verify dimensions by field measurements.

B. Coordinate building and wall penetrations with other construction activities.

C. Coordinate structural support devices and sleeves to be set in cast-in-place concrete and with other structural components as they are constructed.

D. Coordinate connection of electrical systems with existing overhead and underground systems or utility services. Comply with government regulations, utility company requirements and local codes.

E. Install electrical equipment to facilitate servicing, maintenance, ease of disconnection, and minimal interference with other installations.

F. Electrical penetrations, shown on the Drawings or not, through an exterior surface shall be sealed and made water-tight. For metal panels, use a sealant around the penetration on both sides of the wall.

G. Electrical penetrations, shown on the Drawings or not, through the fire resistance rated walls or floors shall be fire stopped as required by NEC using the approved method as recommended by the manufacturer. Fire stops (e.g. caulk) shall have a 3-hour fire resistance rating, and shall be made by the 3M Company, or equal.

H. Electrical penetrations, shown on the Drawings or not, to hazardous areas shall be gas-tight and fire-stopped using “Link-Seal” FD or FS seals as manufactured by Thunderline Corporation, or equal.

I. Multiwire (shared neutral) branch circuits operating at 120 VAC are not acceptable.

3.03 CUTTING AND PATCHING

A. Perform cutting and patching of electrical equipment and materials required to:

1. Uncover Work for the installation of ill-timed Work.
2. Remove or replace defective or damaged Work.
3. Remove or replace Work not conforming to the contract or requiring specified testing.

3.04 DEMOLITION AND CLEANING

A. Electrical equipment, conduit, wire, and appurtenances that are removed shall remain the property of the Owner and shall be stored at a site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.

B. Abandoned conduit and wiring, unless specified or marked as “spare”, shall be removed. Before any removal, consult with the Owner if materials are to be disposed of or reused. In situations where a portion of the conduit run back to its source remains in service, the abandoned conduit shall be removed back to the point where the conduit will remain in services. Resulting conduit stubs shall be plugged.

C. When all Work is completed, tested, and accepted by the Engineer/Owner, the Contractor shall clean all light fixtures, equipment, and exposed surfaces affected by the Work.

D. Contractor shall at all times keep the Work area in an orderly and clean condition by periodic removal of excess and unused materials.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 16020
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Wiring schematics with wire termination points identified.

1) Manufacturer's technical product sheets on each component to be furnished.

b. Field testing certificates, signed by the Contractor, certifying that the field tests comply with the requirements specified in Quality Assurance - Part 1.03.

c. Furnish manufacturer's name(s) and catalog numbers.

d. Manufacturer's recommended method of installation for the products to be furnished.

2. Information for the Record:

a. Manufacturer's qualifications, including a list of similar installations.

1.03 ELECTRICAL AND CONTROL COORDINATION

A. Layout and installation of grounding system and accessories shall be coordinated with other installations.

1.04 PRODUCT HANDLING

A. Deliver ground wire properly packaged in factory fabricated type containers, or wound on NEMA specified type wire reels.

B. Store grounding materials and ground wire in a clean, dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

C. Handle grounding wire carefully to avoid abrading, puncturing and tearing wire insulation. Ensure that dielectric resistance of the cable is maintained.

PART 2 PRODUCTS

2.01 MATERIALS

A. Grounding materials shall be corrosion-resistant and chemically compatible with the materials with which they come in contact.

1. Conduit shall be as specified in Section 16130.

2. Conductors for equipment grounding shall be stranded THHN/THWN or XHHW-2, color-coded green. Equipment grounding conductor size shall not be less than that provided in the latest edition of the NEC, or as shown on Drawings, whichever is larger.

B. Use of conduit system for the ground conductor shall not be permitted.

C. Ground rods shall be copper clad and not less than 3/4 inch in diameter and 10 feet long.

D. Connections:

1. In readily accessible locations, compression or bolted connectors of Burndy Engineering Company or equal shall be used.

2. In locations not readily accessible after installation, splices and connections of grounding cable shall be made by exothermic welding process equal to Cadweld.

E. Where an underground ground ring encircling a building or structure is used, it shall be bare, stranded, copper conductor not smaller than No. 4/0 AWG, unless specified or shown otherwise.

F. Ground Enhancement Material (GEM) shall be permanent, maintenance-free, and maintain its earth resistance with time. GEM in its set form shall have a resistance of not more than 20 ohm-centimeters. GEM shall be as manufactured by Erico Electrical Products, or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Metallic water service pipe, metal frame of a building, concrete encased electrodes, and ground rings surrounding a structure shall be bonded together to form an effective grounding system.

3.02 INSTALLATION

A. System neutrals; secondaries of control power, instrument, metering and relaying transformers; noncurrent-carrying metallic equipment enclosures; exposed metal structures; and supports shall be effectively bonded to ground grids and busses provided under this Contract.

B. Noncurrent-carrying metallic parts, electrical equipment and systems including, but not limited to, transformers, motors, lighting, equipment, raceways, control panels, consoles, panelboards, and cable shields, as well as metallic structures, shall be effectively grounded.

C. Low-voltage electrical equipment, except as otherwise specified, shall be grounded by means of a separate conductor which shall be included in any multi-conductor cable.

D. Electrical continuity of equipment grounding circuits such as metallic raceways shall be assured by bonding where necessary; equipment grounding conductors passing through metallic raceways shall be bonded to the raceways where they enter and leave.

E. Particular care shall be taken to ensure good equipment ground continuity between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

F. Conduits stubbed-up below a floor mounted electrical apparatus shall be fitted with insulated grounding bushings and connected to the electrical apparatus ground bus or structure. Boxes mounted below floor mounted electrical apparatus shall be bonded to the apparatus ground bus.

G. Insulated grounding bushings shall be used on the grounding of all conduits, 480 volts and higher, with copper grounding conductors.

H. Conduits and raceways, regardless of type and material, shall include a separate insulated equipment ground conductor, whether shown on the Drawings or not, sized no less than required by the latest edition of the NEC or by the Drawings, whichever is larger, and connected to the grounding grid. Each circuit grounding conductor shall be dedicated for that circuit.

I. Connections:

1. Exposed connections shall be made by means of approved grounding clamps. In readily accessible locations, compression or bolted connectors shall be used. Exposed connections between different metals shall be sealed with a synthetic base substance in which zinc particles are suspended such as Burndy Penetrox A-13, Thomas & Betts, (Blackburn) Contax or equal.

2. All buried connections shall be made by an exothermic welding process, “Cadweld”, or equal. The tops of all ground rods shall be at least 12 inches below grade.

3. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate

at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

4. Connections at Test Wells: Use compression type connectors on conductors and make bolted and clamped type connections between conductors and ground rods.

5. Compression Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

6. Insulated grounding conductors connected to ground rods or ground buses shall be insulated over the entire area of the connection and sealed against moisture penetration of the insulation and cable.

7. Ground rings shall be in direct contact with earth, buried at a depth of no less than 30 inches, and 20 feet long minimum, unless noted otherwise.

J. Underground Distribution System Grounding:

1. Manholes, Handholes, and Underground Pullboxes: Install a driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a No. 1 AWG bare tinned copper conductor from the ground rod into the manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure sensitive tape or heat shrunk insulating sleeve from 2 inches above to 6 inches below the concrete. Seal floor opening with waterproof, nonshrink grout.

2. Connections at Manholes, Handholes, and Underground Pullboxes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to the ground rod or ground conductor. Connect circuit ground wire to ground rod. Make connections with minimum No. 4 AWG stranded hard drawn copper wire. Train conductors plumb or level around corners and fasten to manhole or handhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits.

3. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

4. Manholes, handholes and underground pullboxes shall have their metal parts bonded to the equipment grounding conductor of circuit(s) passing through them in accordance with NEC Article 250.

K. Isolated Signal Ground:

1. Where shown on the Drawings, provide a minimum No. 2 AWG stranded, tinned, insulated ground conductor from each control panel or remote I/O panel to a designated system ground point. Ground conductor shall be routed in 3/4-inch Schedule 80 PVC conduit from panel location to system ground connection point. Terminate ground conductor at an insulated, isolated ground bus and at system ground point. Connection at ground rods shall be via exothermic welds.

L. The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically driven cranes; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand operated metal shifting ropes or cables of electric elevators, and metal partitions, grill work, and similar metal enclosures around equipment of over 750 volts between conductors.

M. All non-current-carrying metal parts of portable equipment and fixed equipment including their associated fences, housings, enclosures, and supporting structures shall be grounded.

3.03 GROUNDING APPLICATIONS

A. Underground grounding conductors shall be bare, tinned, stranded copper except as otherwise indicated.

B. For telephone, alarm, and communication systems, provide a No. 4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location. All grounds in the telephone system shall be bonded together.

C. Separately derived systems required by the NEC to be grounded shall be grounded in accordance with the latest edition of the NEC.

D. Ground metal poles supporting outdoor lighting fixtures to a grounding electrode as indicated in addition to a separate equipment grounding conductor run with supply branch circuit.

E. For all other equipment grounding conductor applications, comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Use of conduit system for ground conductor shall not be allowed.

F. Bond the telecommunications grounding electrode to the power grounding electrode using No. 6 AWG copper wire minimum.

3.04 TESTING

A. Comply with Section 16050.

B. Testing shall be by independent electrical testing organization to perform tests described below and in Section 16050.

C. Perform a megger test on the completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminals, and at ground test wells.

1. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

2. Perform tests by the two-point method in accordance with IEEE 81, “Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System.” Simple moisture addition is not acceptable.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 16030
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the provision of identification of electrical equipment and materials in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Product data for each type of identification product specified.

b. Manufacturer's name(s) and catalog numbers.

c. Nameplate schedule.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. Comply with requirements of ANSI Standard, "Scheme for the Identification of Piping Systems" and "Wiring and Equipment Identification" with regard to type and size of lettering for raceway and cable labels.

PART 2 PRODUCTS

2.01 NAMEPLATES AND LEGENDS

A. New equipment shall be identified by means of a laminated phenolic nameplate. Modified equipment shall be identified in the same manner as was the original equipment. Equipment whose designation has been changed shall be relabeled as specified or directed.

B. Nameplates shall have white background with black engraved lettering identifying function or equipment designation.

C. Main nameplate on MCC, switchgear, control panel, and other panels shall be 2-inches high by 6-inches wide with 1-inch high letters. Individual nameplates shall be 1-inch high by 3-inches wide with 1/4-inch high letters.

D. Legends shall be completely worded without abbreviations except as approved by the Engineer.

E. Blank nameplates shall be included on all unused components.

F. Nameplates on electrical panels which are fed from a remote source shall include, in addition to their function, where the power originates from (e.g., scum pump panel - fed from MCC-1, MCC-1 fed from main SWG).

2.02 CONDUCTOR IDENTIFICATION

A. Wires and cables, except at lighting and 120 volts convenience outlets, shall be identified by means of tags describing circuit.

B. Tags shall be on all connections, splices, and terminations, and shall also be applied where entering and leaving common wireways.

C. Wire tags shall be equal to Thomas & Betts white, self-adhesive wrap or Panduit heat shrink type labels. Tags shall be vinyl, polyester or Polyolefin, resistant to excessive heat, water, cold, dirt, and grease.

D. The tag type-on-area shall be sufficiently sized to contain five numerals on each line. Wire numbers shall be typed on with Thomas & Betts E-Z Coder Printer, Panduit Dura-Mark Printer or equal.

E. Insulated conductors No. 8 AWG and larger shall be color coded at each end with a 2-inch wrap of suitable color tape as follows, if integral color is not utilized:

System	Phase Conductors A, B, and C	Neutral Conductors
120 volts, single-phase, 2-wire	Black	White
120/240 volts, single-phase, 3-wire	Black and Red	White
208 volts, 3-phase, 3-wire	Black, Red, Blue	--
208Y/120 volts, 3-phase, 4-wire	Black, Red, Blue	White
480 volts, 3-phase, 3-wire	Brown, Orange, Yellow	--
480Y/277 volts, 3-phase, 4-wire	Brown, Orange, Yellow	White
2400 volts, 3-phase, 3-wire	Black, Red, Blue**	--
2400 volts, 3-phase, 4-wire	Black, Red, blue **	White**
4160 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4160 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
4800 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4800 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
Grounding	Green	

** Apply tape near termination on cable.

Tape shall be Scotch #35 in color required above as manufactured by 3M or equal.

F. Direct current conductors shall be identified by the following methods:

1. Provide self-sticking markers on each direct current conductor.
2. Marker colors shall be black letters on “alert orange” background.
3. Each marker shall designate circuit conductor polarity and voltage (e.g. 28 VDC).
4. Direct current control conductors shall be color-coded dark blue.

G. On a 4-wire delta-connected system where the midpoint of one phase winding is grounded to supply lighting and similar loads, the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

PART 3 EXECUTION

3.01 COORDINATION

A. Submit nameplate schedule for review and approval by the Engineer prior to fabrication of nameplates.

3.02 INSTALLATION

A. Contractor shall furnish and install equipment nameplates, typed panel rosters, wire and cable tags, stenciling, and other identification with text, lettering type, etc., as specified in this Section.

B. Nameplates shall be fastened by means of 3/16-inch diameter roundhead, stainless steel, self-tapping screws. UL 508 4X enclosure nameplates shall be secured with silicon adhesive.

C. Pull, terminal, and junction boxes shall be identified by stenciling the names of the feeders and system wires and cables passing through them.

D. MCCs and power panels of NEMA 3R double-door construction shall have stenciled panel designation at the top and branch designations appropriately spaced in the outer doors. NEMA 4X lighting and power panels shall have designations appropriately placed on them.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 16050
ELECTRICAL TESTING

PART 1 GENERAL

1.01 SCOPE

A. Contractor shall furnish all labor, tools, equipment, and materials necessary to perform electrical testing in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and Section 16010 and shall include:

1. Information for the Record:

a. Certified reports of field tests and observations.

1.03 QUALITY ASSURANCE

A. Testing shall be performed or supervised by the Contractor. Contractor shall be responsible for test records.

B. Contractor shall visually check equipment, wire, phase matching and rotation in preparation for testing.

C. Manufacturer's recommended instructions for testing shall be used when applicable.

D. Testing shall be in compliance with accepted engineering practices, NEC and IEEE Standards.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 COORDINATION

A. Before conducting field tests, the Contractor shall submit to the Engineer a written outline of the methods of testing and equipment to be used.

3.02 FIELD TESTING

A. Required testing shall be completed and written report submitted to the Engineer for acceptance before the Contractor proceeds with subsequent Work.

B. Written reports shall be required on tests. Careful records shall be kept of each test and results shall be submitted to the Engineer.

C. Final payment will not be released until all required written test reports are submitted and distributed for information.

D. Contractor shall be responsible for the procurement and installation of compatible components and equipment, and shall perform all Work necessary for the proper operation and guarantee of the equipment.

E. Contractor shall make such tests as may be necessary to demonstrate that the Work and equipment, as installed, comply with the Contract Documents. When required by the Engineer, such tests shall be performed in the Engineer's presence.

F. Any system or equipment failing to meet the Contract requirements, or to function properly, shall be rectified at the Contractor's expense by readjusting or by removing and replacing the faulty Work or equipment, and the tests rerun until the requirements are met.

G. Engineer reserves the right to require the Contractor's equipment be checked by an independent instrument tester.

3.03 CONDUIT TESTING

A. After conduit and accessories have been installed and all concreting operations completed, all conduit runs shall be satisfactorily cleared of all obstructions and foreign matter. Any defects that might damage cable upon installation shall be corrected.

B. Conduits shall be tested, in the presence of the Engineer if requested, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter 1/4 inch less than the inside diameter of the conduit, followed by a stiff wire brush of the same diameter as the conduit. Where conduits installed under this Contract are connected to conduits installed by others, the entire runs between boxes, manholes, or other termination points shall be tested.

C. Contractor shall keep a record, by number, of all conduits tested clear, and shall submit written copies of such record to the Engineer.

D. Defects or stoppages in conduit runs installed by the Contractor shall be corrected. Defects or stoppages in conduit runs installed by others shall be reported to the Engineer, who shall determine the corrective measure to be taken.

3.04 GROUNDS

A. Contractor shall test the ground resistance of the systems.

B. Dry season resistance of each system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, provide additional grounding as directed by the Engineer.

C. Where multiple ground rods are required, they shall be 20 feet apart. The Contractor, in the presence of the Engineer if requested, shall test all made grounds for continuity and resistance. Ground resistance of more than 5 ohms shall be reduced to 5 ohms or less by the use of additional, and properly separated, ground rods, or deep driving of ground rods.

D. In addition, where necessary, Ground Enhancement Material (GEM) shall be used to provide low resistance and high conductivity. GEM shall be installed per manufacturer's recommendations.

3.05 LOW-VOLTAGE CIRCUIT BREAKERS

A. Each low-voltage circuit breaker shall be manually opened and closed five times before being energized.

B. Acceptance of each ground fault device will be only on an in-person trip and reset cycle demonstration for the Engineer or his representative - if the Engineer requests to be present. The Engineer shall be notified at least one week before scheduling this test.

3.06 LOW VOLTAGE SYSTEM (INSULATION RATED AT 600 VOLTS)

A. Contractor shall perform insulation resistance testing of 480-volt power feeder circuits with a 500-volt megger.

B. Written test reports of the results shall be submitted to the Engineer prior to final inspection. Equipment which may be damaged during this test shall be disconnected before the test and reconnected upon completion.

C. Upon the completion of each electrical system rated 600 volts or less, but before wiring connections are made to equipment, the Contractor shall test each circuit and each piece of equipment for:

1. Continuity.
2. Grounds.
3. Insulation resistance, phase-to-phase and phase-to-ground, of 480 volts conductors and equipment with a 500-volt megohmmeter.

D. Discontinuities or grounds discovered in low voltage systems shall be corrected before the insulation resistance is measured.

E. Insulation resistance readings, lower than required by good practices or Code, shall be promptly repaired or replaced. Retesting shall be completed until acceptable readings are acquired.

F. Installed control cables and conductor terminations for instrumentation and controls shall be tested for properly grounded cable shields. Control cable shields shall be isolated from ground except at the grounding point. The Contractor shall remove all

improper grounds at no additional cost to the Owner. This test shall be witnessed by the Engineer if requested.

G. Following satisfactory completion of circuit and equipment insulation resistance tests, connection of the wiring to equipment, but before it is energized; the tests specified above shall again be carried out.

H. Defective or improperly installed electrical equipment or wiring provided or installed and connected by the Contractor shall be repaired, replaced, or properly installed by the Contractor until it satisfactorily passes the field tests.

I. Irregularities or faulty equipment shall be immediately reported to the Engineer.

3.07 RESERVED

3.08 FIBER OPTIC CABLE TEST PROCEDURES

A. Visual and Mechanical Inspection

1. Cables shall be inspected for physical damage and proper connection.

2. Splices and connectors shall be inspected for physical damage and proper connection.

B. Field Tests

1. All cabling and connectors shall comply with and be tested to ANSI/TIA/EIA-568B.3

2. Contractor shall perform cable length measurement and detect fiber fractures, sharp bends, or other defects through analysis of the backscattering signal with an Optical Time Domain Reflectometer (OTDR).

3. Contractor shall perform a continuity test to detect splice fractures of other defects through analysis of the backscattering signal with an Optical Time Domain Reflectometer (OTDR).

4. Contractor shall perform attenuation measurement of the cable loss at a wavelength of 850 or 1300 nanometers.

5. Contractor shall perform attenuation measurement of losses at each splice and connector at a wavelength of 850 or 1300 nanometers.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 16060
HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE

A. Contractor shall furnish all labor, tools, equipment, and materials necessary to provide supporting devices in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include.

1. Shop Drawings for Review:

   a. Manufacturer's technical product sheets on each component to be furnished.

   b. Submit a list of materials needed for construction, giving manufacturers' names and catalog numbers.

2. Information for the Record:

   a. Manufacturer's qualifications.

   b. Certified copies of factory test procedures and results.

   c. Manufacturer's recommended method of installation for the products to be furnished.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. Manufacturer's Standardization Society (MSS):

   a. Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.

2. National Electrical Code (NEC):

   a. Comply with related sections of NEC requirements for equipment, conduit, and raceways.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mounting brackets, bolts, nuts, and washers for items of electrical equipment shall be provided with either an approved zinc plating process, be galvanized, be nonferrous, or be of a non-corrosive metal.

B. Carbon steel hangers, supports, fastenings, and other devices shall have an approved plating process. Manufactured channel sections shall be P-1000 Unistrut with hot dip galvanizing after fabrication, or equal.

C. "Shot-in-place" anchors and fastenings shall not be used. Perforated metal strap or wire is not acceptable for hangers or supports.

D. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

Base Metal	Fastener Metal and Coating
Stainless Steel	Stainless Steel
Aluminum	Stainless Steel
Galvanized Steel	Galvanized or zinc plated carbon steel
Field painted or uncoated carbon steel	Unfinished or zinc plated carbon steel

E. Where a connection involves dissimilar base metals, fastener shall be as required for most corrosion resistant base metal in connection, or dielectric material shall be installed.

F. Anchor bolts and fasteners in submerged applications shall be stainless steel.

G. Non-metallic strut shall be made of pultruded fiberglass with an isophthalic polyester fire-retardant (FR-P) resin.

1. The composite material shall have an ultraviolet light inhibiting chemical additive and meet ASTM E84 for flame spread. It shall have a complete Nexus Veil Coverage (outer surfacing fabric) to provide maximum chemical and UV protection.

2. Non-metallic strut shall be as manufactured by Enduro Composite Systems, or equal.

H. Hanger rod (all-thread) shall be 3/8-inch minimum diameter round steel rod.

PART 3 EXECUTION

3.01 COORDINATION

A. Sequence and coordinate location of hangers and supports to facilitate equipment installation and future access for maintenance.

3.02 INSTALLATION

A. Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten lighting stands, panelboards, transformers, conduits, and other electrical equipment and materials to be installed on, or in, concrete bases or structures which are existing, or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

B. Surface mounted equipment shall be installed in such a manner as to permit free circulation of air on all sides. A minimum space of 1/4 inch shall be maintained between the back of equipment and the mounting surface.

C. Wherever wall, columns, or like structural members are not available for mounting motor starters, push-button stations, and like equipment, hot dip galvanized structural steel sections shall be provided for such mounting, or as shown on the Drawings, shop prime coated, and epoxy finished per Section 09900.

D. Where galvanized or cadmium plated surfaces or materials are cut, drilled, reamed, or damaged during the course of installation, the exposed metal shall be brush-on coated with 95%- zinc-enriched paint.

E. Cut ends of non-metallic strut, such as manufactured by Enduro or equal, shall be brush-on coated with the manufacturer's recommended coating to prevent fibers from fraying.

PART 4 SPECIAL PROVISIONS

4.01 SUPPORT MATERIAL SCHEDULE

A. Exterior – All exterior supports shall be 304 stainless steel.

B. In Chamber or Exposed to Wastewater – All supports shall be 304 stainless steel.

C. Headworks Screen Room, Grit Areas, Container Area, Primary Sludge Pump Station – All supports shall be 304 stainless steel.

D. Electrical/Blower Room and Boiler Room (not included in one of the description above) – carbon steel.

END OF SECTION

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SECTION 16120
CONDUCTORS AND CABLES (600 VOLTS AND LESS)

PART 1 GENERAL

1.01 SCOPE

A. This Section includes 600-volt, single or multi-conductor power or control cable.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's technical product sheets on each component to be furnished.

b. A list of materials needed for construction giving manufacturer's names and catalog numbers.

2. Information for the Record:

a. Manufacturer's recommended method of installation for the products to be furnished.

1.03 QUALITY ASSURANCE

A. Comply with ICEA, UL, NFPA and NEMA publications for "Non-shielded Power Cables rated 2000 Volts or Less."

PART 2 PRODUCTS

2.01 MATERIALS

A. Wires shall be identified by surface markings indicating manufacturer's name, conductor size, conductor material, voltage rating, UL Symbol, type designations, and optional ratings.

B. Conductors shall be oil and gasoline resistant.

C. Single conductors for 600-volt power, lighting, and receptacle circuits shall be Type THHN/THWN dual-rated or XHHW-2 and as follows:

1. Conductors shall be stranded, soft-drawn, or annealed copper.

2. Single conductors for general use for power, lighting, and receptacles shall be a minimum size of No. 12 AWG stranded, unless otherwise noted on the Drawings.

3. Minimum wire size for controls shall be No. 14 AWG unless noted otherwise.

4. Single conductors, for power distribution, No. 4 AWG and larger, shall be Type XHHW-2.

5. Single conductors, for power distribution, smaller than No. 4 AWG for use in conduits and ducts shall be Type THHN/THWN dual-rated.

6. Single conductors, for power distribution where exposed to sunlight, shall be listed and marked as sunlight-resistant as manufactured by Okonite, "Okoguard-Okolon" Type RHH or RHW-2 or USE-2, VH-1, or equal.

D. Underground feeder and branch circuit cable for direct burial in earth shall be Type UF, RHW-2, or USE-2 for use in wet or dry locations. Cable shall include a ground wire and be listed and approved for such application.

E. Interlocked Armored Cable (IAC):

1. Cable shall be suitable for aerial installation, direct burial, metal racks, open trays, troughs, or continuous rigid cable supports.

2. Cable shall include 3 stranded copper conductors, XLP insulation, bare ground copper conductor, aluminum armor, and PVC jacket.

3. Cable jacket shall be UL listed as sunlight resistant. IAC cable shall be capable of operating continuously at a maximum conductor temperature of 90 degrees Celsius in wet or dry locations. Cable shall be as manufactured by The Okonite Company, Pirelli Cables North America, Southwire Company, or equal.

F. Flexible power cords shall be 3 or 4 conductor including ground, No. 12 AWG minimum wire size, rubber insulated, hard service cord, meeting UL requirements for flexible cord. Flexible power cords shall be rated for 600 VAC and have oil resistant thermoset insulation for use in wet locations (Type SOOW). Ampacity shall be in accordance with NEC Table 400.5(A) and any pertinent derating factors.

G. Flexible control cords shall be 2, 3 or 4 conductor, No. 18 AWG minimum wire size, rubber insulated, hard service cord, meeting UL requirements for flexible cord. Flexible control cords shall be rated for 600 VAC and have oil resistant thermoset insulation for use in wet locations (Type SOOW).

H. All wire and cable insulation and all cable outer coverings shall be listed and approved for the conditions under which the wire or cable is to be used.

I. 1000V Variable Frequency Drive Cable

1. Shall be manufactured by Lutze DriveFlex or equal.

2. General: Variable frequency drive cable shall be multiple conductor type and conforming to UL Standards 1277 and 2277

3. Flexible stranded tinned copper conductors per ASTM standard

4. Insulation for current-carrying conductors: Thermoset Type XHHW-2 or RHW-2 Cross-Linked Polyethylene (XLPE)
5. Non-wicking fibrous or insulation material extruded fillers shall be used in cable construction.
6. Conductors shall be configured as either a four-conductor design (three current carrying conductors, plus one equivalent-sized ground) or a symmetrical insulated ground design (three current carrying conductors, plus three symmetrical ground conductors of reduced size)
7. Individually numbered current carrying conductors. Each current carrying conductor shall be labeled clearly and concisely no more than every six inches along the length of each conductor. Ground conductor shall be green/yellow and conform to IEC 60446 Section 5.3.2 and NFPA 79 2018 edition, article 13.2.2.
8. Dual layer shielding for EMC compliance is required. Shielding shall consist of overlapping aluminum mylar foil and tinned copper braid shield. A tinned copper drain wire shall be included on the exterior of the braid shield.
9. Black TPE or PVC jacket with flexible, and oil resistant construction. Specifically formulated for easy stripping during field installation.
10. Cable shall be sunlight resistant and suitable for direct burial.
11. Cables shall be oil resistant.
12. Cable Voltage Rating: Minimum 1000 Volts phase to phase
13. Cable Temperature Rating: 90 degree Celsius for normal operation.

2.02 COMPONENTS AND ACCESSORIES

A. Splicing materials shall be as follows:

1. Plastic tape shall be 3M Scotch Electrical Tape No. 33+ or 88, or equal.
2. Neoprene tape shall be Okonite Company “Okoprene”, or equal.
3. Insulating putty shall be 3M “Scotchfill Electrical Putty”, or equal.
4. Tapes and other splicing materials shall be used only as recommended by the manufacturer, and only if their condition is such as to meet the manufacturer’s standards.
5. Heat-shrinkable tubing shall be Raychem or equal.

B. Connectors:

1. Wire connectors for No. 6 AWG and smaller wires shall have sharp internal threading which prevents pulling off, but are removable. Connectors shall be Type Y, Type R, Type G, or Type B, as manufactured by 3M Company or equal.

2. Indentor butt connectors shall be Burndy “Hylinks”, or equal.

3. Indentor pigtail connectors shall be Thomas & Betts “Sta-Kon” connectors, or equal, applied to the twisted conductors, and covered with a nylon cap of the same manufacturer.

4. Indentor or compression connectors shall be Thomas & Betts “Sta-Kon” connectors, or equal. The insulation of conductors No. 2 AWG and larger shall be penciled to the diameter of the conductor. Wires connected to screw terminal block points shall have fork tongue lug terminals.

5. Splices to uncut main runs shall be made with Burndy “Crimpits”, or equal, for cables No. 4/0 to No. 10 AWG, and Burndy “Hytaps”, or equal, for cables larger than No. 4/0 AWG.

6. Cable fittings for armored cable shall be Crouse-Hinds, or equal, and shall be compatible with the cable used as recommended by cable manufacturer.

7. Bus Bar Taps - Bus bars shall be tapped using one of the following connectors.

   a. Two-hole, crimp-type lugs, 600V - 35 kV, sized as required to match bus bar width and conductor in use. Connector metal shall match bus metal. Connector shall be UL listed as manufactured by Thomas & Betts Catalog No. 542XX, or equal.

   b. Heavy duty compression, 600V - 35 kV, sized as required to match conductor in use. Connector metal shall match bus metal. Connector shall be UL listed as manufactured by Thomas & Betts Catalog No. 251-31446-XX, or equal.

C. Power Blocks:

1. All power blocks whether in terminal boxes, motor control, and other locations, shall be equal to Allen-Bradley Bulletin 1492 UL-listed, 600V AC/DC, 3-pole suitable for copper conductors, and rated for 75 degrees C, minimum.

2. Power blocks shall have sufficient current carrying capacity as required, and shall not be adjacent to control wiring terminal blocks.

D. Wire Pulling Lubricants - Pulling lubricants shall be American Polywater Corp. Type J, Ideal Yellow 77 Plus, Thomas & Betts Polymer Base, or equal. Follow manufacturer’s recommendations for compatibility with wire insulation, cable jacket, and conduit materials.

2.03 IDENTIFICATION

A. All wires and cables, except at lighting and 120 VAC convenience receptacles, shall be identified by means of tags with wire names. Tags shall be on all connections, splices, and terminations, and shall also be applied where entering and leaving common wireway and at a minimum of 30 foot centers within the wireway. Wire tags shall be as specified in Section 16030.

2.04 FACTORY TESTS

A. Wire shall be tested in accordance with:

1. UL Standard for type THHN/THWN wire and the optional Gasoline and Oil Resistant II listings.
2. UL Standard for Type XHHW-2.
3. UL and ICEA requirements for Type MC Cable.

PART 3 EXECUTION

3.01 COORDINATION

A. Inspect raceways for compliance with specifications and Drawings. Do not proceed with installation until defective conditions have been corrected.

B. Conduit layouts shall provide for cable separation between various systems and between various signals within given systems. The combining of conductors of various systems within one conduit system shall not be permitted.

3.02 INSTALLATION

A. Wiring, above ground, 120 volts and higher, shall be in conduit, wireways, or cable trays.

B. Extreme care shall be used to prevent any injury or damage to the wiring. The Contractor shall observe the installation instructions and precautions issued by the manufacturer of the wire and cable.

C. Cables shall be pulled through conduits in such a manner as not to overstress, stretch, score, cut, twist, or damage the protective covering or insulation of the conductor. If mechanical means are employed for pulling the cables or wires, a dynamometer shall be used.

D. The ends of low-voltage cables installed in damp or wet locations shall be carefully sealed until permanently connected or spliced. The Contractor shall be responsible for maintaining a dry condition while the cables are being pulled.

E. Underground circuit cables for direct burial in earth shall be installed per NEC and IEEE Standards, and as recommended by the cable manufacturer.

F. Keep rocks and rough materials away from direct buried cables.

G. Direct buried cable shall be backfilled with 6 inches of sand over the top of cable to prevent stone bruises and cuts to cable.

H. If single conductor cable is used, space cables evenly at least 6 inches between cable centers. Sand shall be used to fill around cables. Be certain there are no cable crossovers.

I. Cables emerging from the ground shall be installed in conduit from at least 18-inch below grade up to the termination point.

J. Spare conductors or cables shall be individually and uniquely numbered. They shall have sufficient length to reach the farthest termination point within the enclosure. They shall be coiled and stored in a neat and workmanlike manner. The coil shall be tagged to indicate the location of the other end of the spare conductors.

K. All 120 volt "home runs" in excess of 100 feet shall be No. 10 AWG minimum. All 120-volt branch circuits supplying heating, air conditioning, or lighting loads of 1500 watts or more shall be No. 10 AWG minimum.

L. Conductors in vertical runs shall be adequately supported with approved conductor supports, as outlined in the NEC.

M. All underground feeder and branch circuit cables for direct burial in earth shall be installed per the NEC, National Electrical Safety Code Section 35, IEEE Standard 590, and as noted on the drawings and as recommended by the cable manufacturer. Cable shall be installed in an "S-Loop" to allow for ground movement. Backfill trench to provide 18 to 24 inches of cover above the top of the highest wire or cable. Place a 6-inch wide, foil-backed, yellow tape with black lettering reading "ELECTRIC LINE" in the trench, and then complete backfilling operations. Tape shall be Thomas & Betts "E-Z-CODE" NAF-0708, or equal.

N. Conductors No. 12 AWG and smaller shall not be in the same conduit with wires No. 6 AWG and larger.

O. Conductor Combination and Separation:

1. The combining of conductors of various systems within one raceway system shall not be permitted. Raceway layouts shall provide for the cable separation requirements between parallel raceways of various systems, and between various signals within given systems throughout Division 16 as required. Each of the following shall be maintained in a separate raceway system apart from the others.
    a. Lighting and 120 VAC utility.
    b. Power Distribution, 600 VAC or less.
    c. Communications Systems (Ethernet).
    d. Analog cables for Instrumentation and Control.
    e. PLC Communications Systems (Data Highway, Modbus, etc.).
    f. Motor Branch Circuits.
    g. Class 3 Motor and Equipment Controls.
2. Where Motor Branch Circuit conductors are less than No. 4 AWG, they may be combined with related Class 3 motor and equipment control conductors.
3. Fiber Optic Cables may share raceways of other systems except where prohibited by the NEC.

3.03 SPLICES AND TERMINATIONS

A. Wire and cable lengths shall be continuous and without splices between the points of connection, except as otherwise specified or indicated on the Drawings.

B. Splices and terminations where specified or indicated on the Drawings shall be made in strict accordance with the conductor manufacturer's recommendations.

C. Splices and connections shall have a conductivity and insulation resistance at least equal to that of the cable.

D. Terminated conductors shall be bundled and identified to match approved Contractor submitted drawings.

E. Owner and Engineer may inspect any and all joints before they are taped. If they are taped without being inspected, the tape may be ordered removed from any joint or joints, and the Contractor shall correct any defect found. After inspection and correction of any fault found, the Contractor shall properly re-tape the joints with new tape.

F. Splices:

1. Dry Locations - No. 6 AWG and Smaller, Single Conductor:

   a. Using either an insulated spring or an indentor butt connector shall be followed by wrapping with two half-lapped layers of approved plastic tape extending a minimum distance of 1 inch from the connector.

2. Dry Locations - No. 4 AWG and Larger, Single Conductor:

   a. No. 4 AWG conductor and larger shall be spliced using indentor or compression connectors, penciled to the diameter of the connector, and wrapped with two half-lapped layers of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor, or 1 inch, whichever is greater.

   b. Splices to uncut main runs shall be made with "Crimpits", or equal, for Cable Nos. 4/0 AWG to 10 AWG, and "Hytaps", or equal, for cables larger than No. 4/0 AWG, and wrapped with two half-lapped layers of approved plastic tape.

   c. Electrical insulating putty shall be used as filler before applying tape, where necessary, to provide a smooth taping surface.

3. Wet Locations:

   a. Single-conductor, with nonmetallic covering, shall be spliced using either indentor (compression) or insulated butt connectors followed by wrapping with four half-lapped layers of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor or 1 inch, whichever is greater.

   b. The insulation of Conductors No. 2 AWG and larger shall be penciled to the diameter of the conductor and wrapped with four half-lapped layers

of approved plastic tape extending a distance from the connector of twice the outside diameter of the larger conductor or 1 inch, whichever is greater.

c. Splices in manholes shall only be permitted where specifically shown on Drawings. Where permitted, in manholes, splices No. 4 AWG and smaller shall be in submersible NEMA 6 terminal boxes within easy reach of ground level.

d. Electrical insulating putty shall be used as filler before applying tape, where necessary, to provide a smooth taping surface.

G. Terminations - When connecting conductors at terminals, the following methods shall be used, unless otherwise specified:

1. Indentor or compression terminals shall be applied to the conductor. Terminals shall be held in place at terminal posts or studs with approved locknuts or lock washers.

2. The shields of shielded, multi-conductor control and metering cables, unless otherwise specified by equipment manufacturers, shall be terminated at one end of the cable only.

3. Shield shall be stripped back, intact, applying a compression grounding terminal to the twisted shield, and securely fastening the terminal to the appropriate point on the equipment or device.

4. Shield at the non-terminated end of shielded cables shall be stripped back at least 2 inches beyond the stripped inner conductor's cutoff, and the cable taped with two half-lapped layers of plastic tape where the shield emerges from the outer sheath.

5. Where dead-ending low-voltage wires and cables, the ends shall be insulated and sealed in a manner similar to a standard splice for the particular location and type of wire or cable.

6. All power system terminations shall be phased-out.

H. Where specified, bus bar tapping shall be in strict accordance with bus bar and connectors' manufacturer's recommendations.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 16121
CONTROL AND SIGNAL CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SCOPE

A. The Section includes the installation of all wire, cable, and terminators for a complete instrumentation and control package.

B. Work shall include but not be limited to the following major items:

1. Communications cable between programmable controller components, processors, graphic interface units, and printers.
2. Communications cable between PLC I/O Panels and programmable controller processors.
3. Programmable controller power supplies to processors and I/O chassis.
4. Analog signal wiring between controls, instruments, equipment, field devices, PLC I/O panels, annunciators, or other instrumentation and control components required to complete the Work.
5. Signal wiring, data highway, fiber optic, conduit materials, and installation not provided under Division 16.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and Section 16010 and shall include:

1. Shop Drawings for Review:
   a. A list of materials needed for construction giving manufacturer's names and catalog numbers.
   b. Manufacturer's technical product sheets on each component to be furnished.
2. Information for the Record:
   a. Manufacturer's qualifications.
   b. Certified copies of factory test procedures and results.
   c. Manufacturer's recommended method of installation for the products to be furnished.
   d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. The installation of equipment and materials shall conform to the recommendations and instructions of the respective manufacturers of equipment and materials.

B. Fiber-optic cable terminations shall be by certified cable installers. The Contractor shall provide a documented listing of fiber optic cable installation experience.

PART 2 PRODUCTS

2.01 CONTROL CONDUCTORS

A. Control conductors shall, unless noted otherwise on the Drawings, be supplied as single conductor, No. 14 AWG, 19 stranded, 600 volts, 90-degree C of Type THHN/THWN dual rated.

B. Wire shall be supplied in three different integral color codes as follows: brown, orange, and red.

C. Intrinsically safe wiring shall be color coded light blue.

D. Direct current control conductors shall be color coded dark blue.

E. Control wire circuits from external sources shall be color-coded yellow.

2.02 TRANSMITTER CABLE

A. Indoor Use:

1. Cable shall be 2-conductor, No. 16 AWG stranded tinned copper with minimum No. 18 AWG stranded tinned copper drain wire.
2. Cable shall have a 100% aluminum foil shield with PVC jacket, rated for 60 degrees C and 600 volts.
3. Cable shall have maximum capacitance of 23 pF (picofarads) per foot between conductors.
4. Cable shall have nominal outside diameter of 0.313 inches.
5. Cable shall be Belden 8719, or equal.

B. Indoor, Outdoor, Transition between Indoor/Outdoor and where subject to damp or wet conditions:

1. Cable shall be 2-conductor, No. 16 AWG stranded, tinned copper with a drain wire. Insulation shall be PVC with a nylon overcoat.
2. Cable shall have a 100% aluminum foil shield with PVC jacket, rated for 90 degrees C and 600 volts. Jacket shall be sunlight resistant.
3. Cable shall be suitable for direct burial and outdoor applications.
4. Nominal outside diameter shall be 0.294 inches.

5. Cable shall be Belden 1118A, or equal.

C. Inside Control Panels and Connected to Analog I/O Modules:

1. Cable shall be 2-conductor, No. 22 AWG stranded tinned copper with polyethylene insulation, and No. 22 AWG stranded tinned copper drain wire. Color code: Black, Clear.

2. Cable shall have a 100% aluminum-polyester foil shield with PVC jacket, rated for 60 degree-C and 300 volts.

3. Cable shall have maximum capacitance of 24 pF per foot between conductors.

4. Cable shall have nominal outside diameter of 0.175 inches.

5. Cable shall be Belden 8761.

D. Transmitter cable shall be identified by the initials “PR”.

2.03 RESERVED

2.04 FIBER-OPTIC CABLES

A. Cable shall be suitable for harsh industrial areas both indoor and outdoor.

B. Cable shall be UL listed for use as non-conductive optical fiber riser cable (OFN/OFNR).

C. Cable shall be suitable for operating temperature between minus 40 degrees C to 75 degrees C, 0% to 100% relative humidity.

D. Cable shall have PE jacket, 6-fibers OM3 50/125/250 micron (core/clad/ buffer).

E. Cable core shall have water blocking compound to prevent water migration into cable.

F. Connectors shall be provided as required and installed as recommended by cable and connector manufacturers. Connectors shall be compatible with equipment to which they will be connected. Connectors shall be as manufactured by 3M, AMP, Corning Cable Systems, Fiber Instrument Sales, Molex, Seiko, or equal.

G. Cable shall have the following characteristics:

1. Crush resistance of 500 pounds per square inch minimum.

2. Impact resistance of 3.3 foot-pounds, 25 impacts minimum.

3. Withstand 25 flexing cycles of 12 pounds and radius of 20 times the cable outside diameter, minimum.

4. Withstand 25 twists per bend cycles of 12 pounds and radius of 20 times the cable outside diameter.

H. Cable shall be Belden FS3C006N0, or equal.

2.05 CATEGORY 5 AND 6 ETHERNET CABLE

A. The Ethernet cable shall be No. 23 AWG solid bare copper with polyolefin insulation, PVC jacketed, unshielded, four twisted pair.

B. DC resistance shall be 28.6 ohms per 1000 feet.

C. Capacitance shall be 15 pF per foot maximum.

D. Nominal velocity of propagation shall be 70%.

E. Cable shall be EIA/TIA 568-B.2-1 Category 6 verified.

F. Suitable applications: Industrial Ethernet Cable, harsh environments, 350 MHz Enhanced Category 6, Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155 ATM, 622 ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Video, RS-422, RJ-45 Compatible.

G. Nominal OD shall be 0.475 by 0.265 inches.

H. Cable shall be Belden 11872A, or equal.

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 ACCESSORIES

A. Control Wiring Terminal Blocks:

1. Terminal blocks, whether in terminal boxes, motor control components, instrumentation, plant communication system, and other locations, shall be Allen-Bradley Bulletin 1492-W4, or equal, suitable for DIN Rail mounting.

2. Separate terminal strips shall be provided for analog and discrete signal wires, with the discrete terminal strip located on the left side of the enclosure.

3. Terminals shall be provided for cable shields.

4. Terminal blocks shall be identified in accordance with Section 16030.

B. Fiber Optic Cable Connectors

1. All outlets, jacks, and connectors shall exceed all requirements of ANSI/TIA/EIA-568B.3.

2. Fiber optic cable connectors shall be capable of terminating optical fiber glass cables with outside diameters ranging from one hundred twenty-five (125) through nine hundred (900) microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms.

3. SC type connectors shall have an insertion loss of not greater than 0.7 dB.

4. All fiber strands shall be terminated with connectors and have a dedicated bulkhead fitting in the fiber patch panel.

5. Splitter or breakout kits shall be provided and installed for each end of loose tube fiber optic cable.

2.10 SOURCE QUALITY CONTROL

A. Wire/cable shall meet IEEE flame test; UL 1581, “Vertical Tray Flame Test”; and ANSI/NFPA Standard 262-1985 (UL-910) “Horizontal Flame and Smoke Test” requirements.

PART 3 EXECUTION

3.01 COORDINATION

A. Examine raceways and other elements receiving cables for compliance with requirements for installation tolerances and other conditions affecting performance of transmission media.

3.02 INSTALLATION

A. Control wiring shall be identified and tagged per Section 16030.

B. Each wire number shall be “solid”, preprinted, and not pieced from single or double digit tags.

C. Wire shall be installed with different color conductor in common conduit, for maximum convenience, with individual conductor identification, which shall be in addition to fiber tag identification as specified herein.

D. The Contractor shall observe the installation instructions and precautions issued by the manufacturer of the wire/cable.

E. Communication cable shall be installed in 1-inch rigid galvanized steel or PVC coated RGS conduit with one cable per conduit.

F. Analog signal cable shall be installed in galvanized rigid steel or PVC coated RGS conduit.

G. No mixing of signal conductors and AC voltage conductors shall be permitted within a single conduit.

H. Instrument cable, communication, and analog signal conduits shall be separated a minimum of 12 inches from any AC voltage source or conductor.

I. Instrument cable shields shall be grounded to a common ground terminal in the control panel unless device manufacturer recommends otherwise. Shields shall not be grounded at the field device or at any intermediate point.

J. Each programmable controller component shall be grounded to earth ground as well as the cable shield between them. Grounding field wiring shall be in accordance with the manufacturer's recommendations. In no case, shall the cable shield be grounded at both ends.

K. Each instrument cable wire shall be identified and terminated at marked terminal strips.

L. Analog instrument cables inside panels shall be justified right as described in Section 16903 and shall terminate at separate terminal strips.

M. Fiber cable loose tube construction

1. Optical fibers shall be surrounded by a tube buffer, be contained in a channel, or otherwise loosely packaged to provide clearance between the fibers and the inside of the container to allow for thermal expansion without constraining the conductor. Cable core shall contain water-blocking compound to prevent water migration into the cable.

2. Fiber optic backbone cable shall be installed in innerduct when within cable tray and three cell Maxcell in conduit.

3. Outdoor cabling shall have a minimum of 10 feet of slack looped in each handhole/manhole.

N. Each instrument cable shall be installed in continuous lengths between terminations. No splicing shall be permitted.

O. 20% spare twisted pairs shall be provided in each conduit run between panels where cables serve more than one device.

P. Conductors carrying high voltage and/or high current shall be installed in separate ducts from low power conductors and PLC component cables.

Q. All cable (power, instrument, communication) in panels shall have the same physical properties as in the field, to minimize the possibilities of transients.

3.03 SPLICES AND TERMINATIONS

A. Spacing between adjacent terminal strips shall not be less than five inches as measured from the individual terminal block edges.

B. Wire and cable lengths shall be continuous and without splices between the points of connection, except as otherwise specified or indicated on the Drawings.

C. Splices and terminations where specified or indicated on the Drawings shall be made in strict accordance with the conductor manufacturer's recommendations.

D. Splices and connections shall have a conductivity and insulation resistance at least equal to that of the cable.

E. Terminated conductors shall be bundled and identified to match approved Contractor submitted drawings.

PART 4 SPECIAL PROVISIONS

4.01 SPARE PARTS

A. Extra terminal block points shall be provided in the quantity of 30% over the quantity used.

END OF SECTION

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SECTION 16122
WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes providing wiring devices in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. A list of materials needed for construction giving manufacturer's names and catalog numbers.

   b. Manufacturer's technical product sheets on each component to be furnished.

2. Information for the Record:

   a. Manufacturer's qualifications.

   b. Certified copies of factory test procedures and results.

   c. Manufacturer's recommended method of installation for the products to be furnished.

   d. Manufacturer's recommended spare parts list for components and accessories.

   e. Operation and maintenance manuals for equipment provided, including accessories, and maintenance instructions.

   f. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 PRODUCT HANDLING

A. Handle wiring devices and components carefully to avoid breakage, impacts, denting, and scouring finishes. Do not install damaged equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Switches shall be specification grade, totally enclosed, quiet tumbler, ac type, meeting NEMA Performance Standards and FS and capable of control of 100% tungsten filament lamp loads.

B. Switches shall be rated at 20 amps, 120/277 volts. Operating handles shall be phenolic colored brown. Switches shall have screw terminals.

C. Receptacles shall be specification grade, meeting NEMA Performance Standards, and FS, and having a contact arrangement such that contact is made on two sides of each inserted blade without detent.

D. Receptacles shall be two-pole, three-wire grounding type with rating of 20 amps, 125 volts, NEMA configuration 5-20R, and have screw-type wire terminals suitable for No. 12 thru No. 10 AWG designated CO/ALR. Bases shall be phenolic composition colored brown.

E. Receptacles for outdoor installation and where shown on the drawings shall be provided with ground-fault protection with push-to-test capabilities.

F. Switches shall be rated 20 amp, 120/277 volts. Switches shall be as manufactured by Appleton Electric Company, Catalog Number EDS175, or equal.

1. Switches shall be factory-sealed, designed to UL Standards. Switches shall be enclosed in separate sealing chambers.

2. Screws and handle shall be stainless steel.

3. Switch shall be clearly marked to indicate ON-OFF position, and shall be lockable in either position.

G. Welding receptacles shall be interlocked with enclosed safety switch and Class RK5 (time delay, dual element) fuses as specified in fuses subsection. Contractor shall furnish the Owner with APJ male plugs with cable grip and neoprene bushing, 3-wire, 4-pole.

H. For flush-mount devices, the Contractor shall provide specification grade, one-piece, 0.040-inch nominal thickness, No. 430 satin finish stainless steel device plates with oval-head, matching mounting screws.

I. For surface-mount or weatherproof devices, the Contractor shall provide cast metal device plates of malleable ferrous metal, with gaskets and oval-head, stainless-steel screws.

J. Wall plates for receptacles located outside of building, and inside of buildings in wet or damp locations, shall be the weatherproof type. Weatherproof receptacles, where exposed to weather or in other wet locations, shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap

inserted), per NEC 406.8. Enclosures shall be as manufactured by TAYMAC Corporation, Tempe, Arizona, RACO, or equal.

K. Where weatherproof switches are designated or required, provide the switch specified mounted in the specified box with a gasketed, weatherproof, cast-metal cover plate incorporating an external operator for the internal switch and with stainless steel mounting screws. Cover plate shall be Crouse-Hinds Cat. No. DS181, or equal.

L. Category 6 Computer Jacks

1. Category 6 computer jacks shall be backwards compatible to Category 3, 5 and 5e.
2. These jacks shall accommodate four pairs of No 22 to No. 26 AWG solid copper wire.
3. Jacks shall be UL 1863 listed.
4. Jacks shall be ETL verified Category 6 components.
5. Jacks shall be IEEE 802.3ab gigabit Ethernet verified.
6. Jacks shall be T568A or T568B wiring standard. However, they must all be the same and match all other equipment whether existing or new.
7. Jacks shall be RJ-45, 8 connector. Coordinate with customer for color of jacks and cover plates.
8. Category 6 computer jacks shall be as manufactured by AMP, Hubbell, Leviton, or equal.

2.02 PERFORMANCE REQUIREMENTS

A. GFCI receptacles which cannot pass their internal test function shall render themselves incapable of delivering power or indicate by visual or audible means that the receptacle must be replaced. GFCI receptacles shall not provide power if the source wires are connected to the load terminals per UL943.

PART 3 EXECUTION

3.01 COORDINATION

A. Switch and outlet boxes shall be cleaned from foreign materials before devices are installed. Wall plates and covers shall be installed after all wall treatments have been completed.

3.02 INSTALLATION

A. Outlet, fixture, and device boxes in unfinished areas shall be surface mounted. Outlet, fixture, and device boxes shall conform to the requirements specified in the paragraphs herein.

B. Concealed galvanized steel outlet and switch boxes for electric lights, wall switches, and receptacles, etc., shall have plaster rings installed where required. In every instance, boxes shall be of such form and dimension as to be adapted to the number, size, and arrangement of conduits connected thereto.

1. Outlet boxes shall be firmly anchored in place, and shall be provided with approved 3/8-inch fixture studs where required.

2. Junction boxes shall be provided with blank covers to match other covers in the same area.

C. Outlets boxes in exterior locations and interior exposed locations shall be “FS” or “FD”, and PVC where used with PVC conduit.

D. Wall mounted convenience receptacles shall be mounted 44-48 inches from the finished floor to the bottom of the box unless shown otherwise on the Drawings, required by the NEC, or where required to clear radiators, grilles, louvers, or other mechanical equipment.

E. Wall mounted switches shall be mounted 44-48-inches above finished floor to the center of the box unless directed otherwise. Space between door openings and switches shall be as uniform as possible throughout the buildings.

F. Special purpose outlets shall be located as shown on the Drawings, or in accordance with project or manufacturer’s requirements.

G. Splices made with wire nuts, crimp connectors, terminal blocks, split-bolts, or similar connectors shall be in boxes that are readily accessible. Terminal boxes shall be located a maximum of 8 feet above finished floor, and shall have a vertical-facing orientation.

H. Unless otherwise required, all receptacles shall be installed vertically with their ground pins up. Where horizontal receptacles are used, they shall be installed with the neutral conductor uppermost.

I. Conventional 120 VAC receptacles shall not be wired to the load side of GFCI receptacles unless both devices are contained in the same box.

J. Isolated ground (IG) receptacles in nonmetallic boxes shall have nonmetallic wall plates.

K. Cables connected to Category 5 and 6 computer jacks shall not have more than 1 inch of the conductors exposed outside of the cable’s outer jacket. No more than 0.5 inch of the individual conductors shall be untwisted.

3.03 TESTING

A. Prior to energizing circuits, test wiring for electrical continuity and for short circuits in accordance with Section 16050. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer's recommendations.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 16130
CONDUIT, SURFACE METAL RACEWAYS, AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to provide conduits and surface metal raceways in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and Section 16010 and shall include:

1. Shop Drawings for Review:

   a. Wiring schematics with wire termination points identified.

   b. A list of materials needed for construction, manufacturer's name and catalog numbers.

   c. Provide conduit layout drawings. All conduit layouts shall show conduits and conduit types with anticipated number, size, and type of power, control or instrumentation conductors/cables, spares and grounds for each and every section of Division 16 requiring separate conduits. Location of floor and wall penetrations and separation between parallel conduits shall be dimensioned.

2. Information for the Record:

   a. Manufacturer's qualifications.

   b. Manufacturer's technical product sheets on each component to be furnished.

   c. Certified copies of field test procedures and results.

   d. Manufacturer's recommended method of installation for the products to be furnished.

   e. Operation and maintenance manuals for equipment provided, including accessories, and maintenance instructions.

   f. Manufacturer's recommended spare parts list for the system components and accessories.

g. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

h. Conduit layouts shall consist of “as-installed” drawings showing the exact location and routing of all conduits and conduit duct banks that are installed in or under paved areas, concrete slabs, direct buried, or otherwise concealed.

i. Conduit layouts shall show conduits with number, size, and type of power, control or instrumentation conductors/cables, spares, and grounds for each and every section of Division 16 requiring separate conduits.

j. Copies of certificates issued by the manufacturer of PVC coated rigid galvanized steel conduit to installers who have successfully completed the manufacturer’s installation training program.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. NEMA.
2. UL.
3. ASTM.
4. NEC.
5. NFPA.

1.04 PRODUCT HANDLING

A. Care shall be taken when handling materials. Deformed conduit and surface metal raceway materials shall not be installed. Conduits and surface metal raceways damaged during construction shall be replaced.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metallic Conduit:

1. Metallic conduit, including couplings, nipples, elbows, and bends shall conform to the Standard for Rigid Metallic Conduit of the UL accessories such as locknuts and connectors shall be zinc-coated for use with hot-dipped galvanized conduit.
2. Rigid galvanized steel conduit shall conform to UL-6 Specification, ANSI C80.1, and FS WW-C581E.

B. PVC Coated Conduit:

1. A plastic coating shall completely encapsulate metallic conduit to provide total protection against corrosion.
2. Conduit shall be galvanized inside and outside, including the threads.
3. Threads shall be coated with urethane over the galvanized threads. A minimum thickness of 40 mil PVC exterior coating shall be permanently fused to the galvanized rigid steel conduit.
4. A urethane or polyurethane interior coating shall be applied at a nominal 2 mil thickness to the interior of the conduit and over the galvanized threads.
5. The PVC coating on all form 8 fittings shall form a gasket-like flange covering the top of the fitting around the opening. All fittings shall have a minimum of 40 mils PVC coating even around the edge of covers.
6. GUA type boxes shall be supplied with WOD type covers. (Feraloy iron instead of aluminum to prevent corrosive reaction between dissimilar metals.)
7. Conduit fittings (couplings, elbows, etc.) shall be of the same material as the conduits and fittings to which they are attached.
8. PVC coated conduit shall be UL listed and conform to the same standards as metallic conduit.
9. PVC coated conduit shall be “OCAL BLUE” as manufactured by OCAL, Inc., “Permacote,” “KorKap” or “Plasti-Bond” as manufactured by Robroy Industries, or equal.
10. Conduit shall be supported by corrosion resistant straps and clamps.

C. PVC Conduit:

1. Conduit shall be a minimum of Schedule 40 for use only when encased in concrete.
2. Concrete encasement for conduits shall be Class B as specified in Section 03300.
3. Schedule 80 shall be used for direct-burial and exposed applications where shown on the Drawings.
4. PVC conduit systems shall conform to FS WC 1094A, ASTM 512, NEMA TC2 and TC3, and to UL 651 and 514 b. All components shall be “Sunlight resistant” and so marked.

D. Flexible Steel Conduit:

1. Flexible steel conduit shall be liquid tight Appleton Electric Company “Sealtite” or equal.
2. Flexible steel conduit fittings shall be Thomas & Betts, Appleton, O-Z/Gedney, or equal.

E. Flexible Metal Conduit - Flexible metal conduit (Greenfield) shall be used only where indicated on Drawings and approved by the Engineer.

F. Explosion-Proof Flexible Conduit:

1. Explosion-proof flexible conduit shall be rated for use in Class I Division 1 Group D or Class II Division 1 Groups E, F and G.

2. Explosion-proof flexible conduit shall be provided with two removable male nipples or with one removable male nipple and one removable male union.

G. Bituminous Coating - All rigid galvanized conduit buried underground shall be coated on the outside with a standard petroleum self-priming asphaltic coating. This material shall meet the requirements of FS TT-V-51F, Varnish: Asphalt. It shall be free of lead and chromate hazards. This material shall be lead and alkali resistant. PVC coated rigid galvanized conduit shall be exempt from bituminous coating requirement.

2.02 CONDUIT FITTINGS - GENERAL

A. Fittings shall be vapor proof, weatherproof, and explosion-proof where so shown on the Drawings and required by NEC.

B. Fittings for use with EMT and Greenfield shall be compatible with the type of conduit, and shall be of the same manufacturer.

2.03 CONDUIT FITTINGS - METALLIC

A. Bushings 1-1/4 inches and larger shall be Type B insulated bushings as manufactured by O-Z/Gedney, Thomas & Betts, or equal.

B. Ground bushings shall be Type BL bushings as manufactured by O-Z/Gedney, Thomas & Betts, or equal.

C. Conduit fittings for use with metallic conduit shall be standard threaded type of cast ferrous construction to suit the location and purpose. Fittings shall be Crouse-Hinds, Appleton Electric, or equal.

D. Covers shall be domed sheet metal, except in corrosive areas, where they shall be cast. All covers shall have gaskets.

E. Exposed fittings, junction boxes, outlet boxes, terminal boxes, etc., shall be cast ferrous material threaded-hub type.

2.04 CONDUIT FITTINGS - PVC COATED

A. Fittings for use with PVC coated conduit shall be compatible with the type of the PVC coated conduit, and shall be of the same manufacturer.

2.05 CONDUIT FITTINGS - PLASTIC

A. Fittings for use with plastic conduit shall be compatible with the type of plastic conduit or duct used, and shall be of the same manufacturer.

B. Adhesives for use with plastic conduit shall be compatible with the type of plastic conduit or duct used and shall be approved by the conduit or duct manufacturer.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with other Work including metal and concrete deck work to interface installation of conduits, surface metal raceways, and support components.

B. Level and square conduits and surface metal raceways and install at proper elevations and heights.

C. Complete the installation of conduits and surface metal raceways before installing any cables or wires.

3.02 OPENINGS AND SLEEVES

A. Electrical penetrations through an exterior surface shall be sealed and made water-tight with a modular mechanical seal of rubber links as manufactured by Link-Seal, O-Z/Gedney, or equal.

B. Electrical penetrations through fire resistance rated walls or floors shall be fire stopped as required by the NEC using the approved method as recommended by the manufacturer. Fire stops (e.g. caulk) shall have a 3-hour, fire-resistance rating, and shall be made by the 3M Company, or equal.

C. Electrical penetrations to hazardous areas shall be gas-tight and fire-stopped using “Link-Seal” FD or FS seals as manufactured by Thunderline Corporation, or equal.

3.03 EXCAVATION AND BACKFILL

A. Excavation and backfill required for the installation of underground conduits shall be done in accordance with Section 02200.

B. Excavation shall not be done until immediately before installation of the specified appurtenances. Cuts shall be done in a workmanlike manner so as to cause the least possible damage.

C. After backfilling, the excavation shall be kept well filled and maintained in a smooth and well-drained condition until permanent surfaces are restored. All surplus excavated material shall be removed and properly disposed of by Contractor.

D. Direct-buried conduit shall be backfilled to provide 18 to 24 inches of cover above the top of the highest conduit.

E. Place a 6-inch-wide, yellow, foil-backed, yellow tape with black lettering reading "ELECTRIC LINE" in the trench, and then complete backfilling operations. Tape shall be Thomas & Betts "E-Z-CODE" NAF-0708, or equal.

F. Directional drilling shall be allowed only in areas known to be free of existing underground piping and electrical systems.

3.04 MOUNTING AND ATTACHMENT

A. Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten conduits to concrete bases or structures which are existing, or provided under other sections of the Contract.

3.05 CONDUIT AND FITTINGS - GENERAL

A. Minimum size of conduit shall be 3/4 inch, except that concealed homeruns, underground, and embedded conduits shall not be less than 1 inch.

B. Conduits shall be located for protection from mechanical damage.

C. Conduits shall be sized in accordance with the NEC and based on 40% fill based on over two wires, or as shown on Drawings, whichever conduit size is larger.

D. Conduit stub-ups between underground or slab construction and exposed or concealed wall construction shall be elbows of rigid metallic conduit, and shall have an ample coating of asphaltic paint prior to the placement of concrete unless otherwise noted.

E. Conduits with free ends not containing conductors shall be threaded and provided with plumber's caps or with couplings and plugs where flush terminations are required.

F. Flexible connections to all equipment subject to movement or vibration shall be made by means of liquid tight flexible steel conduit equal in length to approximately ten times the diameter of the conduit, but not exceeding 3 feet in length. Explosion-proof flexible couplings shall be used in place of liquid tight flexible steel conduit in Class I, Division 1 and Class II, Division 1 hazardous areas.

G. Conduit runs subject to motion in excess of the capacities of the fittings specified above shall be provided with other approved means of compensating for the motion. Unless otherwise specified or required, expansion fittings shall be installed at the midpoint of their extension.

H. Conduits to pumps or other equipment shall, unless otherwise shown on the Drawings, be routed through or below concrete floor slabs.

I. Runs on floor slabs are not permitted unless specifically shown as such on the Contract Drawings.

J. Conduits shall be concealed in all locations where walls are faced with glazed tile or ceilings are suspended and where called for on the Drawings. Wherever conduit is

concealed in masonry of any type, it shall be the responsibility of the Contractor to maintain a clear passageway throughout the entire conduit system, and to clean the conduit system before installing the conductors.

K. Conduit runs in poured concrete structures containing expansion joints, approved expansion/deflection joints shall be provided in the conduit. All such expansion joints shall be made watertight. Similar expansion/deflection joints shall be installed wherever conduit crosses structural expansion joints, or is attached to two separate structures, or wherever the conduit run is more than 100 feet in straight length.

L. Where conduit bushings are constructed wholly of insulating material, a locknut shall be installed both inside and outside the enclosure to which the conduit is attached. Ungrounded conductors of No. 4 AWG or larger shall be protected with insulated throat bushings or hubs where entering or leaving an enclosure in conduit systems.

M. Pulling distances shall be limited to a maximum of 200 feet so as not to exceed the wire manufacturer's maximum pulling tensions, and suitable pull boxes, etc., shall be provided whether shown on the Drawings or not.

N. Unused openings in conduit bodies and cast enclosures shall be plugged using Appleton Cat. No. PL6, or equal.

O. The sum of the conduit bend angles between pull points shall not exceed 270 degrees. Bends in conduit containing medium voltage cables shall have a minimum radius of 36 inches.

P. In hazardous areas, all fittings, material, and equipment shall be rigid metallic steel or PVC coated rigid metallic steel.

Q. Conduits between hazardous and non-hazardous areas shall include seal-off fittings as required by the NEC and local codes, and the complete installation shall be in accordance with the requirements of such codes.

R. Seal-off fittings shall be exposed. Sealing compound shall be "Chico" by Crouse-Hinds, or equal. All components and installation in hazardous areas shall conform to the requirements of NEC and all local codes.

S. Conduits through which moisture may contact live energized parts shall be sealed or plugged at either or both ends per NEC 300.5(G) and 230.8. Spare or unused conduits shall also be sealed. Provide drains and breathers so moisture will not accumulate inside conduit.

T. Conduits subject to motion at right angles to the direction of the run and all conduits in concrete shall be equipped with O-Z/Gedney Type DX, Thomas & Betts, or equal expansion and deflection fittings.

U. Inside surfaces of all conduits shall be free from any imperfection likely to damage conductors or cables during installation.

V. During construction, open ends of conduits shall be capped or plugged to keep out debris. These caps or plugs shall remain in place until wires or cables are pulled through the conduit.

W. Spare conduits and those provided by the contractor for use by others shall have a pull string installed. Coil up at least 24 inches of extra string at each end.

3.06 CONDUIT AND FITTINGS - METALLIC

A. Exposed conduit shall be rigid metallic conduit unless otherwise noted.

B. Rigid metallic conduit shall be installed in true alignment and sloped for drainage wherever necessary; underground conduits shall be drained to manholes or pull boxes.

C. Rigid metallic conduit shall be reamed free from burrs and carefully cleaned before installation.

D. When required, conduit unions shall be provided. Running threads will not be permitted.

E. Conduit fastened directly to structures shall be held with one-hole, malleable iron clamps and clampbacks, or otherwise suitably spaced from concrete or masonry surfaces. Concealed rigid metallic conduit shall be installed in as direct a line as possible and shall be rigidly supported by approved methods and materials.

F. Exposed rigid metallic conduit shall be installed parallel with or at right angles to the lines of the structure, except as otherwise shown, and supported in an approved manner.

G. Conduits entering a NEMA 3R, 4, 4X, or 12 enclosures shall be installed using watertight fittings of die cast zinc material. Fittings shall be Appleton HUB-XXD, or equal.

H. Expansion fittings shall be installed in all rigid metallic conduit runs which cross expansion joints, and shall be Type AX as manufactured by O-Z/Gedney or Thomas & Betts.

3.07 CONDUIT AND FITTINGS - PVC COATED RIGID GALVANIZED STEEL

A. PVC coated rigid galvanized steel (RGS) conduit shall be installed per the manufacturer's instructions. Only tools approved by the manufacturer of the conduit shall be used.

B. Installers of PVC coated RGS conduit must be certified by the conduit manufacturer to install this type of conduit. Proof of certification shall be furnished to the Engineer.

C. PVC coated RGS conduit shall be used wherever shown on the Drawings by the notation "PVC/RGS", and in all areas where highly corrosive or highly humid atmospheres can exist, whether shown on the Drawings or not. Such areas include, but are not limited to, chemical feed and storage areas, solids storage facilities, wet wells, near the surfaces of standing or running water such as in aeration tanks, digestion tanks, open channels, and clarifiers or settling tanks.

D. PVC coated galvanized rigid steel conduit shall only be used with threaded fittings. Threadless fittings shall not be used.

E. The installation of PVC coated RGS conduit shall conform to the requirements for metallic conduit.

F. Before assembly, field-cut threads shall be coated with an electrically conductive compound approved by the conduit manufacturer.

3.08 UNDERGROUND CONDUIT

A. Underground non-concrete encased conduit shall be installed with a detectable warning tape. If the conduit contains a detectable wire, a warning tape shall still be provided. Underground conduit shall be concrete-encased where shown. The top of underground conduit shall be not less than 30 inches below grade unless otherwise specified. Concrete encasement shall provide a minimum cover of 6 inches on top and bottom, and 6 inches on the sides. Horizontal curves, where necessary, shall be drawn on radii of not less than 6 trade diameters of the largest conduit in the duct bank.

B. PVC conduit and fittings for use in underground duct banks shall be Schedule 40. PVC conduit shall be Schedule 80 where direct-buried.

C. Conduits for concrete-encased duct banks shall be securely held in place by approved window type spacer supports, and shall be laid with joints staggered.

D. The ends of each conduit run which is not to contain wiring under this Contract shall be plugged or capped with manufactured plugs or caps.

E. Conduits shall enter manholes and structures at right angles unless otherwise shown.

F. Conduits shall terminate with a bell end at each manhole entrance.

G. Under pavement conduit crossings shall have a 6-inch minimum concrete cover all around and be reinforced as detailed for a length extending 5 feet on each side of the pavement.

H. Slope for drainage away from building interiors shall be provided. Where inverted elevations are specified, they shall be adhered to, unless the Contractor obtains approval on an alternative layout.

I. Concrete for all underground conduit encased in concrete shall be mixed with five pounds of red dye for each cubic yard of concrete. Red topped concrete shall not be permitted instead of red dyed concrete.

3.09 SURFACE METAL RACEWAYS

A. Surface mounted metal raceways shall only be used in dry locations where exposed or under raised floors of information technology rooms per Section NEC 645.5(D)(2).

B. Surface mounted metal raceways shall not be used in Class I hazardous areas, where subject to severe physical damage, where the voltage between the wires is greater than

300 volts, where subject to corrosive vapors, in hoistways, and concealed locations not mentioned in A. above.

C. The number and size of conductors within surface metal raceways shall not exceed what the raceway was designed for. See the manufacturer's installation instructions to determine capacity.

D. Cables shall be permitted to be installed in surface metal raceways only where such use is permitted by the respective cable article in the NEC.

E. Surface metal raceways shall be securely fastened to the surface on which they are mounted in accordance with the manufacturer's instructions.

F. Surface metal raceways shall be grounded and bonded in accordance with NEC Articles 250 and 386.

G. Splices shall not be made within surface metal raceways.

3.10 EXPLOSION-PROOF CONDUIT FITTINGS

A. The cross-sectional area of the conductors permitted in a seal shall not exceed 25% of the cross-sectional area of a rigid metal conduit of the same trade size unless it is specifically listed for a higher percentage of fill.

B. Motors and other devices subject to vibration and movement located in Class I, Division 1 and Class II, Division 1 areas shall be connected using explosion-proof flexible couplings. Explosion-proof flexible couplings may also be used in place of rigid conduit in difficult bend situations.

3.11 BELOW-GRADE GALVANIZED CONDUIT

A. All rigid galvanized conduit buried underground shall be coated on the outside with a self-priming, standard petroleum asphaltic coating. This coating shall have a thickness when dry of at least 1 mil.

B. The asphaltic coating may be dipped, brushed or sprayed on the exterior surface of the conduit.

C. Before application, surface should be free of grease, oil, dirt, fingerprints, drawing compounds, any other contaminant, and surface passivation treatments to ensure optimum adhesion and coating performance properties.

PART 4 SPECIAL PROVISIONS

4.01 CONDUIT LOCATION SCHEDULE

A. Exterior above grade – RGS.

B. Exterior below grade.

1. In duct bank – SCH 40 PVC..

2. Direct bury – SCH 80 PVC.

C. Interior (unclassified) – RGS.

D. Chemical areas –PVC/RGS.

END OF SECTION

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SECTION 16132
ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to provide electrical boxes and fittings in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and Section 16010 and shall include:

1. Shop Drawings for Review:

a. A list of materials needed for construction, giving quantities, manufacturer's name and catalog numbers.

b. Manufacturer's technical product sheets on each component to be furnished.

2. Information for the Record:

a. Manufacturer's qualifications.

b. Certified copies of factory test procedures and results.

c. Manufacturer's recommended method of installation for the products to be furnished.

d. Operation and maintenance manuals for equipment provided, including accessories, and maintenance instructions.

e. Manufacturer's recommended spare parts list for the system components and accessories.

f. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Applicable Standards:

1. UL.

2. NEMA.

3. FS.

4. NEC.

PART 2 PRODUCTS

2.01 MATERIALS

A. Except as otherwise specified in non-corrosive areas, metallic outlet, device, terminal, junction, pullboxes and conduit fittings shall be appropriate to the related conduit specification.

1. Cast ferrous metal boxes shall be used with rigid galvanized conduit. Threaded openings shall have a minimum of 5 threads and neoprene-gasketed, cast covers held in place with stainless steel screws.

2. Boxes whose weight in cast ferrous metal would exceed 75 pounds shall be made of sheet steel with 5-thread bosses and neoprene-gasketed covers held in place with stainless steel screws. Similarly, sheet aluminum boxes shall be provided in the larger sizes.

3. Boxes larger than 6-inch shall be equipped with cap screws and hinged covers.

B. In areas designated as NEMA 4X, outlet, device, terminal, junction and pullboxes shall be NEMA 4X of stainless steel or FRP. Sheet metal boxes where permitted above, shall be NEMA 4X watertight boxes made of 12-gauge stainless steel.

C. Terminal and junction boxes used for control, signal, or communication wiring shall be NEMA 4X stainless or FRP, except where located in a dry area or electric room, where they shall be NEMA 12. Terminal boxes shall have white-painted backplates, barriered terminal blocks of sufficient quantity for all field taps and for all spare deadends.

D. Cast boxes used indoors in non-corrosive locations not subject to flooding or hosing shall:

1. Be dust-tight equal to O-Z/Gedney Electrical Manufacturing Company Type YU flush boxes and Type YS surface boxes.

2. Include mounting lugs, with threaded openings having a minimum of 3 threads and neoprene-gasketed covers held in place with stainless steel screws.

E. Sheet-metal boxes where permitted, including junction boxes and pullboxes at motor control centers, shall be hot-dip galvanized NEMA 12 with neoprene-gasketed covers held in place with stainless steel screws.

F. Checkered covers shall be provided for boxes in floors or sidewalks.

G. Concealed outlet and switchboxes for electric lights, wall switches, and receptacles, etc., shall consist of standard galvanized steel boxes and plaster rings where required. Boxes shall be National Steel City or equal.

H. Outlets in exterior locations or in exposed conduit shall be “FS” or “FD”, and PVC where used with PVC conduit.

I. Interior junction boxes and gutters shall conform to NEC thickness and dimensional requirements, minimum.

J. Cut edges or knockouts on all FRP boxes shall be sealed with a catalyzed resin compatible with the original resin and as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

2.02 MANHOLES AND CONCRETE PULLBOXES FOR UNDERGROUND INSTALLATION

A. The Contractor shall provide all manholes and concrete boxes for underground electrical utilities as shown or required, including excavation, concrete, steel reinforcing, backfill, metal frames and covers, cable racks, pulling irons, and the restoration of adjacent areas to their original condition.

1. Steel reinforcing and concrete for manholes and concrete pullboxes shall be Class A, as specified in Section 03200 and Section 03300, respectively.

2. Manholes shall be constructed for H-20 loading. The cable racks shall be connected to the grounding system and to a ground rod in the manhole.

3. Manhole maybe constructed of precast concrete in accordance with Section 02551 and Section 02552.

B. Signal manholes shall be 48 inches wide, 48 inches long and 72 inches high inside dimensions, unless specified otherwise on the Drawings. Electric manholes shall be a minimum of 60 inches wide, 84 inches long, and 72 inches deep, or as shown on the Drawings.

1. Manhole frames and covers shall be heavy-duty Neenah R-1792 Series, with R-1792 GL solid lids marked “Electric” for electric manholes, and with R-1792 FL solid lids marked “Signal” for signal manholes.

2. Electric and signal manholes shall have access openings of 26-1/2 inches, and pulling-in-irons shall be provided as directed at the Site.

3. Concrete pullboxes, signal, and electric manholes shall not have any conductor splices in the enclosure, unless approved by the Engineer.

C. All 5-15 kV conductors installed in manholes and pullboxes shall be fireproofed. Fireproofing (arcproofing) tape shall be 30 mil thick (minimum) by 3 inches wide, and applied tightly around each cable spirally in one-half lapped wrapping, or in two butt-jointed wrapping with a second wrapping covering joints in first wrapping.

1. Install tape with coated side toward cable and extended not less than 1 inch into conduit. Install random wrappings of plastic tape around installed fireproofing (arcproofing) tape to prevent unraveling.

2. Fireproofing (arcproofing) tape shall be similar and equal to 3M Company No. 77 and the installation shall conform to the manufacturer’s recommendations. Over the No. 77 tape, install a layer of 3M No. 69 scotch glass tape in a half-lapped wrapping.

PART 3 EXECUTION

3.01 COORDINATION

A. Layout and installation of electrical cabinets, boxes, and fittings shall be coordinated with other installations.

3.02 INSTALLATION

A. Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Install items where indicated and where required to suit code requirements and installation conditions.

1. Cap unused knockout hole where blanks have been removed and plug unused conduit hubs so as to maintain the NEMA rating of the box.

2. Install boxes in locations which ensure ready accessibility to enclosed electrical wiring and avoid installing boxes back to back in walls where there would be less than 6 inches (150 mm) separation. Fasten boxes firmly and rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

3. Do not install aluminum products in concrete.

C. Outlet and device boxes for flush mounted installation shall be a minimum of 4 inch square or octagonal and positioned accurately to allow for surface finish thickness.

D. Junction boxes, pullboxes, and enclosures with hinged doors which are surface mounted shall utilize spacers to maintain 1/4-inch clearance from the wall.

E. Floor boxes shall be installed level and flush with finished flooring material.

F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and secure connections when fastened with locknut or bushing on rounded surfaces.

G. Provide electrical connections for installed boxes.

3.03 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

3.04 CLEANING AND FINISH REPAIR

A. Upon completion of installation, inspect components, remove burrs, dirt, and construction debris, and repair damaged finish including chips, scratches, abrasions, and weld marks.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 16251
SURGE PROTECTIVE DEVICES (SPD)

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing and installing surge protective devices (SPD) and related equipment in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Submit manufacturer's technical product sheets on each component to be furnished, giving conductor size, type and length, dimensions, manufacturer's name and catalog numbers.

b. Submit prototype test results of proposed equipment indicating short circuit current rating (SCCR) and compliance with UL requirements indicating a nominal discharge rating of 20 kA.

2. Information for the Record:

a. Manufacturer's recommended method of installation for the products to be furnished.

b. Operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Materials described herein shall be furnished by a single supplier who shall be responsible for the performance of the equipment in its entirety. The responsibility shall not be split among suppliers of individual components.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

C. Manufacturer shall provide documentation showing the SPD meets the requirements of UL1449, 3rd Edition.

1.04 GUARANTEE

A. Manufacturer shall provide a minimum of a ten-year replacement warranty for any SPD part failure.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Unit shall have an engineered solid-state high performance suppression system, utilizing arrays of fused nonlinear voltage dependent metal oxide varistors with similar operating characteristics.

B. Suppression system platform shall be balanced to provide equal impedance paths for surge currents to ground, in a seamless low stress manner ensuring maximum performance.

C. The unit shall have a maximum continuous operating voltage (MCOV) rating of 115% of the system's nominal operating voltage. The MCOV shall be a tested value as defined in Section 377.3 of UL1449, 3rd Edition.

D. Units for wye configured electrical systems shall have directly connected suppression elements between line-line, line-neutral, line-ground, and neutral-ground.

E. Units for delta configured electrical systems shall have suppression elements between line-line and line-ground.

F. Units for Split Phase, 3 wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground and neutral-ground.

G. Units for 3 Phase, High Leg Delta, 4 Wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground, neutral-ground, high line-neutral and high line-ground.

H. SPD shall have a high-performance noise rejection filter. Attenuation for electric line noise shall be minimal per UL standards.

I. Units shall not consist of plug-in type modules or printed circuit boards as surge current conductors. All internal components shall be hardwired with connections using low impedance conductors or copper bus and compression fittings.

J. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit. Service Entrance units shall include a surge counter alarm and dry contact output for remote alarm indication.

K. Service Entrance Unit shall incorporate an integral test point allowing easy off-line diagnostic testing to verify the operational integrity of the unit's suppression/filter system.

L. Provide enclosure of NEMA 12 rating unless shown otherwise on the Drawings or in Part 4 of this Specification.

M. SPD shall be as manufactured by Eaton Innovative Technologies, Surge Suppression, Inc., APT, or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with other Work, including painting, and electrical boxes and wiring work as necessary to interface orderly installation of all Work.

3.02 INSTALLATION

A. Verify that neutral to ground bond is present and voltage form neutral to ground is less than 5 VAC on three phase wye, split phase and high-leg delta systems.

B. Install SPDs as indicated in the manufacturer's written instructions and other recognized industry practices.

C. Install SPD as close as practical to the device to be protected in accordance with applicable manufacturer's instructions and local or national code requirements.

D. Connections shall be with low impedance bus or minimum No. 8 AWG, copper conductor. Leads shall not be any longer than necessary, avoid unnecessary bending of conductors.

E. Ground SPD per manufacturer's recommendations and in accordance with Section 16020.

F. If permanently attached leads provided with the SPD need to be extended, in-line butt splices shall be used. Connectors, such as wire nuts, that introduce a pointed connection are not acceptable.

3.03 INSPECTION, STARTUP, AND TRAINING

A. Demonstrate that the SPD is installed correctly and functioning properly prior to energizing equipment to be protected.

B. Contractor shall provide four hours of field training to Owner by a factory trained representative on proper procedures to operate diagnostic test equipment. Coordination of this training shall be made with Owner's schedule.

PART 4 SPECIAL PROVISIONS

4.01 SURGE PROTECTIVE DEVICE SCHEDULE

A. The following schedules are intended to aid the Contractor in identifying SPD location and rating. It is intended to supplement the Drawings and Specifications and is not guaranteed to be complete. All SPD shown on the Drawings shall be furnished and installed by the Contractor whether listed in the schedules or not.

B. The rating of the SPD for the service entrance disconnect shall be rated at least 150,000 amps per Phase. SPD for service entrance overcurrent protective devices rated above 2000 amps shall be based on the table below this Section.

C. The rating of the SPD for Motor Control Centers, Power Panels or Switchgear downstream of the main service entrance disconnect shall be based on the following tables below this Section.

Main Overcurrent Protective Device	Amps Per Phase
0 – 800 Amps	50 kA
801 – 2000 Amps or Service Entrance	150 kA
2001 – 4000 Amps	200 kA
Greater Than 4000 Amps	300 kA

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Overcurrent Protective Device	NEMA Enclosure*
MDP-30		480	3	3	500	12

D. The SPD for Lighting Panels shall have 48,000 Amps per Phase protection and be the Sine Wave Tracking type.

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Circuit Breaker	NEMA Enclosure*
LP-30		120/208	3	4	175	12

* SPD's if mounted in separate enclosure inside Motor Control Centers, Power Panels, Lighting Panels or Switchgear by the manufacturer shall have the same enclosure rating as the equipment they are installed in.

END OF SECTION

SECTION 16410
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install panelboards in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's technical product sheets on each component to be furnished. Submit shop drawings for each panelboard including dimensioned plans and elevations, component and device lists, a single line diagram showing main and branch bus current ratings, and short circuit ratings of panelboard.

b. Furnish manufacturer's name(s) and catalog numbers.

2. Information for the Record:

a. Operation and maintenance manuals.

b. Upon completion of the installation and acceptance by the Owner and Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, and related support materials shall be corrected and amended to reflect the installed system.

1.03 QUALITY ASSURANCE

A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these drawings and specifications.

B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

C. Equipment and material shall be furnished by manufacturer of panelboards whose products have been in satisfactory use in similar service for not less than five years.

D. Applicable Standards:

1. NEC – Comply with NEC Article 408 as applicable to installation and construction of electrical panelboards and enclosures.

2. UL – Comply with applicable requirements of UL 67, "Standard for Panelboards," and UL Numbers 50, 869A, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures.

   a. Provide panelboard units that are UL listed and labeled.

3. NEMA – Comply with NEMA Standards Pub/No. 250, "Enclosures for Electrical Equipment (1,000 volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

1.04 ELECTRICAL AND CONTROL COORDINATION

A. Layout and installation of panelboards shall be coordinated with other installations including loads that the panelboard feeds, clearances in front of and above panelboards, and ratings of the panelboard(s).

1.05 PRODUCT HANDLING

A. Deliver panelboards properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.

B. Store panelboards in original packaging and protect from weather and construction traffic. Wherever possible, store indoors. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle panelboards carefully to prevent physical damage. Do not install damaged switches or breakers, remove from Site and replace damaged devices with new.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Except as otherwise specified, low-voltage panelboards shall be factory-finished, dead-front assemblies of individually removable, bolted circuit breakers and NEMA standard copper mains and busses, enclosed in code-gauge, surface-mounting steel cabinets. The backboxes shall be continuously welded and galvanized after fabrication. Panelboards shall not exceed 78-inches in height, and shall be so mounted that height of the top operating handle will not exceed 6-feet, 7-inches from the floor. Shorter panelboards shall be mounted proportionately lower.

B. Panelboards shall be UL listed and conform to FS W-P115, Type I, Class 1, and all applicable ANSI, IEEE, and NEMA standards.

C. Panelboards shall be shop tested in accordance with NEMA standards.

D. All panelboards shall include, whether shown on the Drawings or not, a Surge Protection Device (SPD) as specified in Section 16251.

E. Panelboards shall be equipped with hinged doors. Doors taller than 30-inches shall have three hinges and doors taller than 42 inches shall have 3-point catches. A directory frame with glass or approved plastic cover shall be provided on the inside of each door and shall contain a typewritten directory listing all active and inactive circuits. Each door shall be equipped with a stainless-steel cylinder lock and hinges. The Contractor shall furnish two panelboard keys with tag identifications per panel to the Owner. Panel fronts shall not be removable with the door locked. Panelboards shall have a solid copper neutral and a separate copper ground bar.

F. Metal nameplates shall be secured to dead-front with rivets or screws. Nameplates shall contain system information, catalog number, and factory order number. Sticker or foil nameplates are not permitted. Interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating shall be displayed on the interior.

2.02 INTERIORS (208Y/120 AND 120/240 VOLTS)

A. Continuous main current ratings as indicated on associated Drawings, not to exceed 600 amps maximum. Minimum Short Circuit Current Rating shall be 10,000 RMS symmetrical interrupting capacity. Panelboards rated for 208Y/120 volts or 120/240 volts shall be Type NQOD as manufactured by Square D, or equal.

B. Provide one copper continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboards shall be suitable for use as Service Equipment.

C. All current carrying parts shall be insulated from ground and phase-to-phase.

D. Interior trim shall be of dead-front construction to shield user from energized parts.

E. Interiors shall be field convertible for top or bottom incoming feed. Main and sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amps shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

2.03 RESERVED

2.04 MAIN CIRCUIT BREAKER IN PANELBOARDS

A. Molded case circuit breakers shall have overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole.

B. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping. Circuit breakers frame sizes above 100 amps shall have a single magnetic trip adjustment located on the front of the breaker which allows the user to simultaneously select the desired trip level of all poles.

C. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

2.05 BRANCH CIRCUIT BREAKERS IN PANELBOARDS

A. Breakers shall be UL listed with amperage ratings and number of poles as indicated on the Drawings.

B. Molded case branch circuit breakers shall have bolt-on type bus connectors.

C. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping.

D. There shall be two forms of visible trip indication. The breaker handle shall be trip free and reside in a TRIPPED position between ON and OFF. In addition, there shall be a VIS-TRIP indicator appearing in the clear window of the circuit breaker housing.

E. In addition to standard ON/OFF markings, circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position by rivet or bolt. Clip on means will not be permitted.

F. The exposed faceplates of all branch circuit breakers shall be flush with one another.

G. All circuit breakers for 120 volts, 277 volts, and fluorescent, LED and HID lighting circuit shall be approved for switching duty, and shall be marked SWD.

H. Branch circuit breakers for 120/208/240/277-volt circuits shall be Type Q with 10,000-amp minimum interrupting capacity. Breakers shall be operable in any position, shall be bolted to mains, and shall be removable from the front of the panelboard without disturbing adjacent units.

I. Ground Fault Circuit Interrupters (GFCI) shall be provided where listed in the panel schedules. GFCI shall be Class A, 4-6 mA.

J. Equipment protection circuit breakers (EPD) with UL Listed 30 mA equipment protection shall be provided where listed in the panel schedules.

K. GFCI and GFEPD branch circuit breakers shall have “push-to-trip” and “reset” devices for maintenance and testing purposes.

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 LABELS

A. Provide products that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the NEC, Article 100.

B. Install label inside enclosure identifying the type of circuit breaker installed, its overcurrent rating, its interrupt rating and the UL class. Where applicable, trip settings and time delays should be provided on permanent labels.

PART 3 EXECUTION

3.01 INSTALLATION

A. Locate independently mounted circuit breakers and install in accordance with manufacturer’s written installation instructions.

B. Circuit breakers in distribution equipment shall be factory installed.

C. Install wiring between circuit breakers and load devices as specified in Section 16120.

D. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and UL 486B.

E. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

F. Upon completion of installation, inspect devices, and remove paint splatters, other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

G. Dead-front trim shall have pre-formed twistouts or plastic inserts designed for the purpose covering unused mounting spaces.

H. Directory cards shall be typewritten and list all active circuits. Inactive circuits shall be labeled: SPARE.

3.02 IDENTIFICATION

A. Identify components in accordance with Section 16030.

3.03 TESTING AND INSPECTION

A. Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.

B. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

C. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

D. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

SECTION 16411
SWITCHBOARDS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install switchboards in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Submit shop drawings for each switchboard including dimensioned plans and elevations, component and device lists, and a single line diagram showing main and branch bus current ratings and short time and short circuit ratings of switchboard.

b. Submit shop drawings of spare fuse cabinet showing material, dimensions, and features including storage provisions for fuse cartons.

c. Submit schedule of features, characteristics, ratings, and factory settings of individual protective devices.

d. Furnish manufacturer's name(s) and catalog numbers.

e. Furnish manufacturer's technical product sheets on each component to be furnished.

2. Information for the Record:

a. Operation and maintenance manuals.

b. Panel Schedules

B. Upon completion of the installation and acceptance by the Owner and Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, and related support materials shall be corrected and amended to reflect the installed system.

1.03 QUALITY ASSURANCE

A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and specifications.

B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

C. Equipment and material shall be furnished by an established, reputable manufacturer, shall be of top-quality construction, design, and shall be guaranteed to perform the service required.

D. Applicable standards:

1. NEC.
2. NEMA.
3. UL.

E. Field Testing Organization Qualifications: To qualify for acceptance, the testing organization must demonstrate, based on evaluation of organization submitted criteria conforming to ASTM E699 that it has the experience and capability to conduct satisfactorily the testing indicated.

F. Product Selection for Restricted Space: The drawings indicate maximum dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Switchboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.

1.04 PRODUCT HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to assure avoiding condensation.

C. Handle switchboards in accordance with NEMA Standard PB2.1, “General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards.” Use factory installed lifting provisions.

1.05 GUARANTEE

A. The Contractor shall warrant the completed system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of the completed and certified test or from the date of first beneficial use.

PART 2 PRODUCTS

2.01 MATERIALS:

A. 480-volt Switchboard: Furnish and install, as shown on the Drawings, a service and distribution switchboard as specified herein, for 480 volts, 3 phase, 4 wire system, unless noted otherwise.

B. The switchboard enclosure shall be NEMA 12 indoor construction. Switchboard shall be of the modular type construction with the required number of vertical sections bolted

together to form one metal enclosed rigid switchboard. The sides, top, and rear shall be covered with removable screw-on code-gauge steel plates.

1. Switchboard shall include all protective devices and equipment, as listed on drawings, with necessary interconnections, instrumentation, and control wiring.
2. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips.
3. Switchboard shall be constructed in accordance with the latest NEMA PB-2 and UL 891 standards.

C. The bus shall be silver plated copper of sufficient size to limit the temperature rise to 65 degrees C, based on UL tests. The bus shall be braced for 65,000 amps symmetrical, and supported to withstand mechanical forces exerted during short-circuit conditions when directly connected to a power source having the indicated available short-circuit current.

1. The through bus on the end section shall be extended and pre-drilled to allow the addition of future sections with standard splice plates. Grade 5 bolts will be used at bus joints. Ground bus and lugs shall be furnished.
2. Ground bus shall extend the entire length of the switchboard, and shall be firmly secured to each vertical section.

D. Individual sections shall be front accessible and the rear of all sections shall align. Incoming line termination, main device connection, and all bolts used to join current-carrying parts, shall be installed so as to permit servicing from the front only so that no rear access is required. The branch devices shall be front-removable and panel-mounted, with line and load side connections front accessible.

E. The main protective device, to be installed in the main device section, shall be a quick-make, quick-break, trip-free, heavy-duty type molded-case circuit breaker. It shall be a 3-pole 600-volt breaker with a LSIG trip current rating as indicated on the drawings and an interrupting capacity of not less than 65,000 amps RMS symmetrical, at the system voltage.

F. All branch circuit molded-case circuit breakers, shall be of quick-make, quick-break, trip-free thermal-magnetic type, with frame, trip, and voltage ratings, 3-pole, as indicated on the plans. All breakers shall have an interrupting capacity of not less than 65,000 amps RMS symmetrical at the system voltage. All breakers shall be removable from the front of the switchboard without disturbing adjacent units.

1. Comply with additional requirements of Section 16431.

G. A ground-fault protection system shall be included when indicated on the Drawings. It shall consist of:

1. An adjustable current sensor enclosing all phase and neutral conductors of the circuit to be monitored (zero sequence method).

2. Appropriate relaying equipment to provide the desired ground-fault current sensitivity and time-current response characteristics.

3. Installation of the equipment shall, in all respects, be in accordance to the manufacturer's recommendations.

H. Provide a digital meter General Electric PQMII-A at each 480V main with Multinet-FE serial to ethernet module. Provide potential and current transformers of the proper size and rating for the application. Provide shorting terminal blocks for all current transformers. Meter shall have Ethernet connectivity via CAT 6 cable.

I. Switchboard and circuit breakers shall be as manufactured by Eaton.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install switchboards and accessory items in accordance with manufacturers' written installation instructions.

B. Anchor each switchboard assembly to two 4-inch minimum channel iron sills arranged in accordance with manufacturer's recommendations. Attach by tack welding or bolting. Level and grout sills flush with switchboard mounting surface.

C. Provide and install housekeeping pads for all switchboards.

D. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences, and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of the switchboards.

F. Tighten grounding connections to comply with tightening torques specified in UL Standards 486A and 486B.

G. Ground equipment to main electrical ground bus indicated. Provide maximum 5-ohm ground resistance at switchboard location.

H. Tighten switchboard bus join bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque tightening values. Where manufacturer's torque values are not stated, use those specified in UL Standards 486A and 486B.

3.02 IDENTIFICATION

A. Comply with Section 16030.

B. Identify field-installed wiring and components and provide warning signs.

C. Identify units, devices, controls, and wiring with factory applied labels and signs.

D. Compartment nameplates shall be engraved laminated plastic for each compartment, mounted with corrosion resistant screws.

3.03 INSPECTION, START-UP, AND TRAINING

A. Comply with applicable standards of the INETA including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."

B. Pretesting: Upon completing installation of the system, perform the following preparation for tests:

1. Make insulation resistance tests of switchboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests for circuits.

3. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

4. Provide manufacturer's instructions for installation and testing of switchboard to test organization.

C. Quality Control Testing Program: Conform to the following:

1. Program objective: to assure switchboard installation meets specified requirements, is operational within specified tolerances, provides appropriate protection for systems and equipment, and is suitable for energizing.

2. Make field tests and inspections and prepare switchboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

3. Schedule tests and notify the Engineer or Owner at least one week in advance of test commencement.

4. Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and remedial efforts.

5. Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, person responsible, and date.

D. Visual and Mechanical Inspections: Include the following inspections and related work:

1. Inspect for defects and physical damage, testing laboratory, labels, and nameplate compliance with up-to-date circuit connections.

2. Verify that potential transformers, including their overcurrent protection and current transformers, meet specified requirements.

3. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

4. Check switchboard anchorage, area clearances, and alignment and fit of components.
5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque valves.
6. Clean switchboard interior and exterior using manufacturer's approved methods and materials.
7. Perform visual and mechanical inspection and related work for circuit breakers and fuses as specified in Sections 16431 and 16432.

E. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.04 PROTECTION

A. Apply temporary heat in accordance with manufacturer's recommendation within each section of switchboards throughout periods during which the switchboard is not in a space that is continuously under normal control of temperature and humidity.

PART 4 SPECIAL PROVISIONS

4.01 EXTRA MATERIALS

A. Spare Fuses: Provide six spares of each type and rating of fuse and fusible devices used. Include spares for:

1. Potential transformer fuses.
2. Control power fuses.

END OF SECTION

SECTION 16421
MOTOR CONTROL CENTER

PART 1 GENERAL

1.01 SCOPE

A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install Motor Control Center(s) in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Furnish manufacturer's product data, test reports, and materials certifications as required.

b. Wiring diagrams from manufacturer including single line, elementary control, and schematics showing internal and external wiring. All control schematics shall use ladder type diagram format incorporating line numbers, and format shall be as defined by NFPA 79, Annex D. Independent wire numbers shall be assigned for each circuit.

c. Time current characteristic curves for overcurrent protective devices including overloads, circuit breaker trip devices, and fuses.

d. Recommended overload device settings

e. Footprint layout, including back-to-back units or front only arrangement with overall dimensions and weights. Also include dimensions for shipping splits and available conduit space.

f. Furnish manufacturer's name(s) and catalog numbers.

g. Furnish manufacturer's technical product sheets on each component to be furnished with voltage; continuous current and short circuit withstand ratings as applicable.

h. Name plate schedule.

2. Information for the Record:

a. Operation and maintenance manuals.

B. Upon completion of the installation all Drawings and related support material shall be corrected and amended to reflect the installed system. All final Drawings and electronic copy (CD) (AutoCAD format) shall be turned over to the Owner.

1.03 QUALITY ASSURANCE

A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these Drawings and Specifications.

B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

D. Applicable Standards:

1. NEC.
2. UL.
3. NEMA.

1.04 PRODUCT HANDLING

A. Deliver Motor Control Centers properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage. Motor Control Center(s) shall be visually inspected upon delivery from factory. Damaged equipment shall be replaced at no additional cost to Owner.

B. Store Motor Control Centers in original packaging and protect from weather and construction traffic. Store indoors, above grade and enclose with watertight wrapping.

C. Handle Motor Control Centers carefully to prevent physical damage. Do not install damaged switches, circuit breakers or starters, remove from Site, and replace damaged devices with new.

D. Follow manufacturer’s recommendations for handling and storage.

PART 2 PRODUCTS

2.01 MAIN AND FEEDER DISCONNECTS

A. Feeder switches and circuit breakers shall have current rating that is shown on the Drawings or described in the Specifications.

B. Switch handles and faceplates shall indicate rated ampacity. Standard construction switches shall be UL listed.

C. In addition to standard ON/OFF markings, switch handle accessories shall provide provisions for locking handle in the ON and OFF position by safety lockout hasps and padlocks.

D. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.

E. Main Disconnect

1. The withstand rating of the main switch or circuit breaker shall be greater than or equal to the bus bracing for the MCC.
2. Provide lugs to accommodate the size and quantity of conductors per phase shown on the Drawings.
3. If no overcurrent protection is indicated, provide a main incoming lug compartment.
4. Main Fusible Disconnect as indicated on the Drawings.
    a. Size fuses as shown on the Drawings. Provide dual element, time delay Class J or dual element, time delay, Class RK5 fuses through 600 amps. Provide time delay Class L fuses above 600 amps.
    b. Provide one normally open and one normally closed auxiliary contact.
5. Main circuit breaker disconnect as indicated on the Drawings
    a. Size the circuit breaker frame and trip sizes as shown on the Drawings.
    b. Provide a circuit breaker of either the thermal magnetic or solid state type.
    c. Provide one normally open and one normally closed internal auxiliary contact.
6. For circuit breakers rated 1,000 amps trip and greater, provide integrated ground fault protection with adjustable pick-up and adjustable time-delay as noted on the Drawings.

F. Feeder Disconnects and Transformer Disconnects

1. The disconnecting means for feeders, integral MCC equipment, and transformers shall be thermal magnetic circuit breakers or fused disconnects as indicated on the Drawings.
2. The interrupting capacity rating shall be greater than or equal to the bus bracing requirement.
3. The minimum circuit breaker frame size shall be 150 amps.
4. Provide one internally mounted auxiliary contact. This contact shall be closed when the circuit breaker is ON and open when the circuit breaker is OFF or TRIPPED.

2.02 STARTERS

A. Starter primary overcurrent protective devices shall be adjustable, instantaneous only, motor circuit protectors (MCP) or fused disconnect switches with Class R or Class J current limiting fuses as indicated on the Drawings. All starter overcurrent fuses shall be

furnished and installed by the Contractor as shown on the Drawings. Contractor shall verify equipment nameplate data and compare against drawing load information. Notify Engineer of any discrepancies.

B. In addition to standard ON/OFF markings, switch handle accessories shall provide provisions for locking handle in the ON or OFF position by safety lockout hasps and padlocks.

C. Combination across the line starters shall be NEMA Size 1 as a minimum. Starters shall be complete with:

1. Disconnecting means: motor circuit protector or fused disconnect switch as indicated on the drawings.
2. NEMA rated starter wired out to terminal blocks in the cubicle section.
3. Control power transformer with two primary and one secondary fuses shall be provided by Motor Control Center manufacturer unless noted otherwise on the Drawings. The transformer shall have sufficient capacity to serve the connected load and limit voltage variation to 10% during operation. Each transformer shall have an additional 100 VA capacity above the standard size for the respective starter. Therefore, no control power transformer shall have a capacity less than 150 VA.
4. Class 10, externally reset, solid state overloads with phase loss protection.
5. Transformer type, incandescent, push-to-test pilot lights as indicated on the Drawings.
6. Pushbuttons and selector switches, as indicated on the Drawings, wired out to terminal blocks in the cubicle section as indicated on the Drawings.
7. Low energy, interposing relay for size 3 starters and greater.

D. Schematics for each cubicle shall be provided, along with unique individual wire numbers.

E. Starters shall be listed for use as full voltage non-reversing (FVNR), full voltage reversing (FVR), two speed two winding (TS2W) or two speed single winding (TS1W).

F. Provide auxiliary contacts wired out to terminal blocks in starter cubicles for the following:

1. Unit disconnecting means for on/off/tripped indication (1 NO and 1 NC).
2. Starter Coil Energized for motor running indication (2 NO and 2 NC per coil).
3. Starter Coil Energized for Hold-in contact (1 NO per coil).
4. Reversing or Two Speed starter interlocking contacts (1 NC per coil).

G. Starters shall have replaceable power contacts.

H. Each starter and relay coil shall be provided with a transient suppressor.

I. Contactors used for control of loads other than motors shall meet all the above requirements for starters. However, overloads shall not be required for contactors unless noted otherwise on the Drawings.

2.03 SURGE PROTECTION DEVICE (SPD)

A. Unit shall have an engineered, solid-state, high performance suppression system, utilizing arrays of fused nonlinear voltage dependent metal oxide varistors with similar operating characteristics.

B. Suppression system platform shall be balanced to provide equal impedance paths for surge currents to ground, in a seamless low stress manner ensuring maximum performance.

C. The unit shall have a continuous maximum operating voltage rating of 115% of the system's nominal operating voltage.

D. Units for wye configured, 3 phase, 4 wire electrical systems shall have directly connected suppression elements between line-line, line-neutral, line-ground, and neutral-ground.

E. Units for delta configured, 3 phase, 3 wire electrical systems shall have suppression elements between line-line and line-ground.

F. SPD shall have a high-performance noise rejection filter. Attenuation for electric line noise shall be per UL standards.

G. All internal components shall be hardwired with connections using low impedance conductors or copper bus and compression fittings. Units shall not consist of plug-in type modules or printed circuit boards as surge current conductors.

H. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.

I. Unit shall incorporate an integral test point allowing easy off-line diagnostic testing to verify the operational integrity of the unit's suppression/filter system.

J. Provide enclosure of NEMA rating as shown in the schedule.

K. SPD shall be as manufactured by Eaton Innovative Technologies, or equal.

2.04 RESERVED

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

2.08 GENERAL ASSEMBLY FOR MOTOR CONTROL CENTERS

A. Motor Control Centers shall be dead front, fully bussed, front accessible, with one or more vertical sections bolted together to form a rigid free-standing assembly. Sections shall have covered, full width horizontal and full height vertical wireway. Sections containing full height units shall not require vertical wireways. Wireways shall be isolated from all bussing and unit interiors. Wiring shall be NEMA Type 1B as a minimum.

B. Enclosure shall be NEMA 12 rated for general indoor units unless noted otherwise and NEMA 4X for outdoor units. Indoor units in areas having open channel flow shall be NEMA 4X.

C. Bussing shall be 3 phase, 4 wire tin plated copper unless otherwise noted.

D. Motor Control Centers shall include tin plated copper ground bus, which is rated at a minimum per the main service feed to the unit.

E. Motor Control Centers shall have 42,000-amp minimum interrupting capacity when used on 480 volt systems. Amp and interrupting capacity ratings shall be as shown on the Drawings.

F. Motor Control Centers shall be factory assembled and tested before being broken down into shipping splits. Maximum shipping split width shall be 60 inches.

G. Each unit primary disconnect shall employ an operating mechanism interlocked with the unit door that will prevent access unless the disconnect handle is in the OFF position. The operating mechanism shall be interlocked with the unit door to prevent switching disconnect operating handle to the ON position while the door is open. A defeater mechanism shall be provided to bypass these interlocks.

H. The operating mechanism shall be interlocked with each unit such that the unit cannot be inserted or withdrawn while the disconnect handle is in the ON position. This interlock feature shall be non-defeatable.

I. Motor Control Centers shall be manufactured by Allen-Bradley, Square D, Cutler-Hammer, or equal.

2.09 LABELS

A. Provide products that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the NEC, Article 100.

B. Install label inside enclosure identifying the type and NEMA size of motor starter installed, its overcurrent rating, its interrupt rating and the UL class. Where applicable, trip settings and time delays should be provided on permanent labels.

C. Provide arc flash warning labels wherever live parts may be accessed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Layout of starters, breakers and switches shall be matched with the front layouts and single line diagrams on the Drawings or as specified and shall be coordinated with other equipment installations for size adjustments if required. This includes Contractor checking of motor horsepower, current and voltage ratings during installation to confirm actual size.

B. Locate shipping split sections and hardware to reassemble the Motor Control Centers and install in accordance with manufacturer's written installation instructions. In the absence of specific manufacturer's requirements install Motor Control Centers in accordance with NEMA publication Number ICS 2.3 "Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers."

C. All loose supplied equipment shall be installed in the Motor Control Centers and adjusted if necessary.

D. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and UL 486B.

E. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

F. All Motor Control Centers shall be mounted on 4-inch high concrete housekeeping pads provided by the Contractor.

G. Upon completion of installation, inspect devices. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

H. Surge Protection Device (SPD)

1. Install surge protection devices as indicated in the manufacturer's written instructions and the NEC.

2. Install SPD as close as practical to the Motor Control Center main bus in accordance with manufacturer's instructions and local and national code requirements.

3. Connections shall be with low impedance bus or minimum No. 8 AWG, copper conductor. Leads shall not be any longer than necessary, avoid unnecessary bending of conductors.

4. Ground SPD per manufacturer's recommendations and in accordance with NEC Article 250.

5. If permanently attached leads provided with the SPD need to be extended, in-line butt splices shall be used. Connectors, such as wire nuts, that introduce a pointed connection are not acceptable.

6. Contractor shall provide eight hours of field training to Owner by a factory trained representative on proper procedures to operate diagnostic test equipment. Coordination of this training shall be made with Owner's schedule.

3.02 IDENTIFICATION

A. Identify components in accordance with Section 16030 Electrical Identification.

B. Individual nameplates shall be labeled to match single lines along with the main Motor Control Center nameplate.

3.03 TESTING AND INSPECTION

A. Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.

B. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

C. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

D. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

E. Prior to energization of Motor Control Center(s), check for phase-to-phase and phase-to-ground insulation resistance levels to be up to standards. Also, check for electrical continuity and any short circuits or grounded circuits.

F. Check all motors for correct rotation and change phases of motor leads as required to correct the rotation.

G. Demonstrate that the TVSS is installed correctly and functioning properly prior to energizing Motor Control Center bus to be protected.

H. Perform pertinent tests and inspections listed in Section 16050.

PART 4 SPECIAL PROVISIONS

4.01 SPARE PARTS

A. Contractor shall provide a minimum of 10% spare fuses of each size installed with at least 3 of each size to be the minimum. This includes the control power transformer primary and secondary fuses.

B. Contractor shall provide at least 3 spare indicating lights of each type installed.

4.02 SURGE PROTECTION DEVICE SCHEDULE

A. The rating of the SPD for Motor Control Centers that serve as service entrance equipment with main overcurrent protective devices rated 2,000 amps or less shall be rated at least 160,000 amps per phase. SPC for service entrance equipment with main overcurrent protective devices rated above 2000 amps shall be based on the table below.

B. The rating of the SPD for non-service entrance rated Motor Control Centers shall be based on the following table:

Main Overcurrent Protective Device	Amps Per Phase
0-800 Amps	80,000
801-2,000 Amps	160,000
2,001-4,000 Amps	320,000
Greater than 4,000 Amps	640,000

1. The schedule is as follows:

Location	Tag	Voltage	Phase	Wire	Main Overcurrent Protective Device	* NEMA Enclosure
MCC-30		480V	3	3	100	12

* SPD mounted inside Motor Control Centers, by the manufacturer shall have the same, or better, enclosure rating as the equipment they are installed in.

C. Schedules are not guaranteed to be complete. All SPD shown on the Drawings or specified shall be provided by the Contractor whether or not listed in the above schedule.

END OF SECTION

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SECTION 16430
DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SCOPE

A. This Section defines the requirements necessary to furnish and install circuit and motor disconnect switches in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's technical product sheets on each component to be furnished.

b. Furnish manufacturer's name(s) and catalog numbers.

2. Information for the Record:

a. Manufacturer’s recommended method of installation for the products to be furnished.

b. Operation and maintenance manuals.

c. Manufacturer's recommended spare parts list for the components and accessories.

d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

1.03 ELECTRICAL AND CONTROL COORDINATION

A. Layout and installation of disconnect switches and accessories shall be coordinated with other trades and with motor horsepower ratings.

1.04 PRODUCT HANDLING

A. Deliver disconnect switches properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.

B. Store disconnect switches in original packaging and protect from weather and construction traffic. Wherever possible, store indoors. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle disconnect switches carefully to prevent physical damage. Do not install damaged disconnect switches, remove from Site and replace damaged devices with new.

PART 2 PRODUCTS

2.01 FUSED SAFETY SWITCHES

A. Provide individual fused switches as specified, shown on the Drawings, or as directed.

B. Fused switches shall have a minimal short-circuit rating of 100,000 amps, RMS symmetrical.

C. Where shown on the drawings, provide fused switches that lock in the ON position. Field modifying to provide this feature shall not be permitted. Where the service disconnect is locked in the ON position, branch circuit overcurrent devices shall be located in a readily accessible location and shall be of a lower amp rating than the LOCKED-ON service overcurrent device per the NEC.

D. Disconnect switches located outdoors, in process areas, damp locations, wet locations, and indoors below grade shall be NEMA 4X stainless steel unless noted otherwise on the Drawings. Disconnect switches located indoors in dry, non-process areas above grade shall be NEMA 12 unless noted otherwise on the Drawings. Provide switches that can be locked in the OFF position. Enclosures shall be mechanically interlocked to prevent the opening of the cover with the switch in the ON position.

E. Fused switches shall be quick-make, quick-break, motor-rated, load-break, heavy duty (HD) type having external marking clearly indicating ON and OFF positions.

F. Provide fuses of the current ratings indicated and types specified in Section 16432 on fuses. Utilize rejection fuse clips that accept only Class RK1/RK5 fuses.

G. Disconnect switches for motors driving process equipment shall have two normally open auxiliary contacts. One shall be wired to disable the motor controller when the switch is open. The other shall be wired to signal the Plant Control System (PCS) that the equipment is "In Service." Disconnect switches for motors driving utility equipment shall have one normally open auxiliary contact. It shall be wired to disable the motor controller when the switch is open.

H. Switches shall be UL listed and horsepower rated for 250 VAC or DC or 600 VAC as required. Lugs shall be UL listed for copper cable. All fused switches shall include equipment grounding bar.

I. Where required by the NEC, fused safety switches shall be rated for use as service entrance equipment.

J. Disconnect switches shall be Square D, Crouse-Hinds, Cutler-Hammer, or equal.

2.02 NONFUSED SAFETY SWITCHES

A. Provide non- fused switches with the same provisions as for fused switches but without fuse clips.

B. Disconnect switches for motors driving process equipment shall have two normally open auxiliary contacts. One shall be wired to disable the motor controller when the switch is open. The other shall be wired to signal the Plant Control System (PCS) that the equipment is "In Service." Disconnect switches for motors driving utility equipment shall have one normally open auxiliary contact. It shall be wired to disable the motor controller when the switch is open.

C. For applications in which all of the conditions listed in the following (1 thru 4) are met, the safety disconnect switch shall be a Crouse-Hinds NSSC manual motor starting switch, or equal, with a high-impact, fiberglass-reinforced polyester, corrosion-resistant, dust-tight, watertight, weatherproof enclosure rated NEMA 3, 4X, and 12 containing a two or three pole switch, as required by the application. Each switch shall have provisions to be pad locked in the off position. Each switch shall be UL listed and horsepower rated for 250 VDC or VAC, or 600 VAC as required. Lugs shall be UL listed for copper cable. Each switch shall include an equipment grounding plate for 3/4-inch and 1-inch conduit.

1. Auxiliary contacts are not required for interlocking or remote monitoring.
2. The driven equipment is not process related; e.g., overhead door operator, electric hoist, HVAC equipment, etc.
3. The motor is three-phase rated 10 hp or less at 460 VAC, 7-1/2 hp or less at 230 VAC, or single-phase rated at 2 hp or less at 230 VAC, or 1 hp or less at 115 VAC.
4. Motor overload protection is not required, or is provided separately by a separate device in the motor circuit.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install disconnect switches for use with motor driven equipment, motors, and controllers, within sight of the motor position where indicated.

B. Provide suitable means for mounting disconnect switches.

3.02 TESTING

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at Site, then retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

PART 4 SPECIAL PROVISIONS

4.01 FUSES

A. Provide and install fuses for all fused disconnect switches along with a minimum of 3 spare fuses of each size supplied.

END OF SECTION

SECTION 16431
CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SCOPE

A. This Section defines the requirements necessary to furnish and install circuit breakers in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's technical product sheets on each component to be furnished showing dimensions and ratings for voltage, amperage and maximum interruption.

b. Furnish manufacturer's name and catalog numbers.

2. Information for the Record:

a. Manufacturer's recommended method of installation for the products to be furnished.

b. Operation and maintenance manuals.

c. Manufacturer's recommended spare parts list for the components and accessories.

d. Manufacturer shall provide time/current characteristic trip curves (Ip and I2t let-through curves for true current limiting circuit breakers only) for each type of circuit breaker.

1.03 QUALITY ASSURANCE

A. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.

C. Equipment shall meet applicable standards of NEC, NRTL, OSHA, UL, and NEMA.

PART 2 PRODUCTS

2.01 MAIN CIRCUIT BREAKER IN LIGHTING AND POWER PANELBOARDS

A. Molded case circuit breakers shall have overcenter, trip-free, toggle mechanisms which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole.

B. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping of all poles.

C. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

D. Lugs shall be UL listed to accept solid or stranded copper conductors. Lugs shall be suitable for 75 degrees C rated wires. Lug body shall be bolted in place. Snap-in designs are not acceptable.

2.02 BRANCH CIRCUIT BREAKERS IN LIGHTING AND POWER PANELBOARDS

A. Breakers shall be UL listed with amperage ratings and number of poles as indicated on the Drawings.

B. Plug-in type circuit breakers that are backfed and used as main circuit breakers in “Main Lugs Only” panelboards shall be secured in place by an additional fastener that requires other than a pull to release the device from the bus bar assembly.

C. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping.

D. There shall be visible trip indication. The breaker handle shall be trip free and reside in a TRIPPED position between ON and OFF.

E. In addition to standard ON/OFF markings, circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position by rivet or bolt. Handle accessories shall be by the same manufacturer as the circuit breaker. Clip on locking means will not be permitted.

F. The exposed faceplates of all branch circuit breakers shall be flush with one another.

G. All circuit breakers for 120 volts, 277 volts, and fluorescent and HID lighting circuits shall be approved for switching duty, and shall be marked SWD.

H. Branch circuit breakers for 120/208/240/277-volt circuits shall have a minimum of 10,000-amp interrupting capacity. Breakers shall be operable in any position, and shall be removable from the front of the panelboard without disturbing adjacent units.

I. Ground Fault Circuit Interrupters (GFCI) shall be provided where listed in the panel schedules. GFCI shall be Class A, 4-6 mA.

J. Ground Fault Equipment Protection Devices (GFEPD) shall be provided where listed in the panel schedules. GFEPDs shall have a trip setting of 30 mA.

K. Arc Fault Circuit Interrupters (AFCI) shall be provided where listed in the panel schedules. AFCIs shall meet or exceed the requirements of UL Standard 1699. AFCIs shall trip if they detect a line to neutral arcing fault of 75 amps or greater. They shall also trip for line to ground faults of 5 Amps or greater.

L. GFCI, AFCI, and GFEPD branch circuit breakers shall have a “push-to-trip” device for maintenance and testing purposes.

M. Lugs shall be UL listed to accept solid or stranded copper conductors. Lugs shall be suitable for 75 degrees C rated wire, unless noted otherwise.

2.03 RESERVED

2.04 RESERVED

2.05 MOTOR CIRCUIT PROTECTORS

A. Motor Circuit Protectors (MCP) are intended for use in combination with motor starters with overload relays for the protection of motor circuits from short circuits. They also serve as the disconnecting means for the motor circuit.

B. MCPs shall contain a magnetic trip element in each pole with the trip point adjustable from the front. There shall be a common adjustment screw or knob to set the trip point of all three poles with one operation.

C. The magnetic trip point on the MCP shall be adjustable from three to ten or eleven times the continuous current in at least eight steps to permit the motor to start without nuisance tripping due to inrush current.

D. MCPs shall be recognized components under UL489 (Molded Case Circuit Breakers) and tested for short-circuit protection in equipment listed under UL508 (Industrial Control Equipment) and UL845 (Motor Control Centers).

E. MCPs shall have a minimum of 65,000 amp interrupting rating at 480 VAC.

F. MCPs shall be 3-pole devices with an internal common trip crossbar to provide simultaneous tripping of all three poles.

G. Select the amp rating of the MCP based on the full load current of the motor to be protected and the MCP manufacturer’s recommendations or sizing table.

H. MCPs shall be as manufactured by Cutler-Hammer, Square D, or equal.

2.06 RESERVED

2.07 LABELS

A. Provide products that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the NEC, Article 100.

2.08 IDENTIFICATION

A. Identify components in accordance with Section 16030.

2.09 MANUFACTURER

A. Circuit breakers shall be as manufactured by Square D, Cutler-Hammer, or equal.

PART 3 EXECUTION

3.01 COORDINATION

A. Locate independently mounted circuit breakers and install in accordance with manufacturer’s written installation instructions.

B. Install wiring between circuit breakers and control/identification devices as specified in Section 16120.

3.02 INSTALLATION

A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL standards.

B. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC.

C. Tighten connectors to comply with tightening torques specified in UL standards to assure permanent and effective grounding.

D. Upon completion of installation, inspect devices. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

E. Install labels inside enclosure identifying the type of circuit breaker installed, its overcurrent rating, its interrupt rating and the UL class. Where applicable, trip setting and time delay information shall be provided on permanent labels.

F. The MCP trip setting for all motors, except Design E motors, shall be at least 115% but not more than 1300% of the full load current shown on the motor’s nameplate.

However, settings up to 1700% of the motor's full load current are permitted for Design E motors.

3.03 INSPECTION, START-UP, AND TRAINING

A. On circuit breakers with adjustable trip settings, the contractor shall coordinate with the circuit breaker manufacturer, or their authorized agent, verification that the ratings and settings are appropriate for proper coordination with other system protection devices. All settings shall be identified and adjusted before circuit breaker is energized.

B. Where discrepancies are found, Contractor or the manufacturer's representative shall recommend final protective device ratings for approval by the Owner and Engineer.

C. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

D. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

E. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

3.04 PROTECTION

A. Panelboards and installed circuit breaker equipment shall be covered and protected from physical damage and construction dirt and debris until ready to be placed into service.

PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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SECTION 16450
DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE

A. This section includes furnishing and installing single phase and three phase general purpose individually mounted dry-type distribution transformers with primary voltages less than or equal to 600 VAC of the two-windings, self-cooled type, complete and in place, ready for service.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. General arrangement drawings, kVA rating, primary and secondary voltage, impedance.

   b. Wiring schematics and termination identifications

   c. Manufacturer's data sheets including all maintenance data, No-load sound level, Full-load sound level, temperature rise, No-load losses and Full-load losses.

2. Information for the Record:

   a. Manufacturer's qualifications.

   b. Manufacturer's storage and handling requirements.

   c. Equipment acceptance test procedures.

   d. Certified factory test reports.

   e. Sound level test reports.

   f. Field test reports.

   g. Equipment warranty.

   h. Operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Transformers shall be designed, constructed, rated, and tested in accordance with UL, NEMA, ANSI, IEEE, NFPA, and OSHA standards.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years.

C. Manufacturers shall be registered firms in accordance with ISO 9001:2000; which includes the design and manufacture of low voltage dry-type power, distribution, and specialty transformers.

D. Transformers and accessories described herein shall be furnished by a supplier who shall be responsible for the performance of the equipment in its entirety.

1.04 PRODUCT HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. A copy of these instructions shall be included with the equipment at the time of shipping.

1.05 GUARANTEE

A. Transformers shall be warranted against defects in materials, workmanship, and performance for five years after the date of substantial completion.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Transformers smaller than 15 kVA shall be totally enclosed non-ventilated with continuously wound coils and shall be completely encapsulated in a polyester resin compound to provide a shock-resistant, moisture-proof, seal. Insulation temperature class shall be based on 180 degrees C system minimum.

B. Transformers 15 kVA and larger shall be a ventilated, dry-type with a UL listed 220 degrees C insulation system minimum.

C. Transformer cores shall be constructed with low hysteresis and eddy current losses. Magnetic flux densities shall be below the saturation point to prevent core overheating by harmonic voltage distortion and load current offset.

D. Cores for transformers greater than 600 kVA shall be clamped utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core.

E. Completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap.

F. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.

G. Transformer enclosure shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

H. Transformers shall be constructed of a rugged steel base suitable for lifting with a fork lift vehicle.

I. Transformers shall have a securely attached nameplate providing complete electrical ratings, wiring diagrams, tap connections and catalog numbers as applicable.

J. Indoor/outdoor transformers shall be dry-type, self-ventilated, 3-phase, 60 Hz with delta-connected primaries and 208Y/120-volts secondaries or single-phase primary and 120/240-volts secondary. Units located outdoors shall be rated NEMA 3R rain-tight and provided with weather shield kit. Ratings shall be kVA as indicated on the Drawings.

K. Transformers rated up to 15 kVA shall have provisions for wall mounting. Transformers rated 20 kVA and above shall be floor mounted.

L. Transformers shall be UL listed 506 or 1561.

M. Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections, and catalog number as applicable.

2.02 PERFORMANCE REQUIREMENTS

A. Transformers shall be supplied with NEMA standard taps in the high voltage windings. Exact voltages and taps to be designated in the transformer schedule of Part 4.

B. Transformer sound levels shall meet the requirements as established by NEMA ST-20:

1. Up to 9 kVA - 40 dB.
2. 10 to 50 kVA - 45 dB.
3. 51 to 150 kVA - 50 dB.
4. 151 to 300 kVA - 55 dB.
5. 301 to 500 kVA - 60 dB.
6. 501 to 700 kVA - 62 dB.
7. 701 to 1000 kVA - 64 dB.
8. 1001 to 1500 kVA - 65 dB.

C. Transformers shall be provided with high-voltage taps as follows:

Three-Phase 480 Volts Delta Primary – 208Y/120 Volts Secondary	
0–9 kVA	2-5.0% of Full Capacity Below Normal
15 kVA	4-2.5% of Full Capacity, 2 Above and 2 Below Normal
30-300 kVA	6-2.5% of Full Capacity, 2 Above and 4 Below Normal
500 kVA	4-2.5% of Full Capacity, 2 Above and 2 Below Normal
750 kVA	4-3.5% of Full Capacity, 2 Above and 2 Below Normal
1000 kVA	2-5.0% of Full Capacity, 1 Above and 1 Below Normal
Single-Phase 480 Volts Primary – 120/240 Volts Secondary	
0-25 kVA	2-5% of Full Capacity Below Normal

D. Transformers shall utilize the insulation system that has been temperature classified and approved by UL. Transformers shall be capable of operating at 100% of nameplate rating continuously in an ambient temperature of 40 degrees C.

The winding temperature rise shall be as follows:

Three-Phase 480 Volts Delta Primary – 208Y/120 Volts Secondary	
0-15 kVA	115 degrees C
0-1000 kVA	150 degrees C
Single-Phase 480 Volts Primary – 120/240 Volts Secondary	
0-25 kVA	115 degrees C

E. Dry-type transformers shall not exceed the sound pressure level of dB(A) over the load range measured 3 feet from the transformer as follows:

0-9 kVA	40 dB(A)
10-50 kVA	45 dB(A)
51-150 kVA	50 dB(A)
51-300 kVA	55 dB(A)
301-500 kVA	60 dB(A)

F. Transformer impedance shall be as high as possible for transformer size so as to reduce available short circuit current.

2.03 ACCESSORIES

A. Transformers located indoors subject to moisture conditions shall have weather shields.

B. Transformers located outdoors shall have NEMA 3R enclosures.

C. Transformers in corrosive areas indoors or outdoors shall have stainless steel enclosures.

PART 3 EXECUTION

3.01 INSTALLATION

A. Floor-Mounted Units - Provide concrete housekeeping pad(s) for floor mounted units in accordance with Section 03300.

B. Anchor transformer to floor with Type C expansion anchors in accordance with Section 05500.

C. Tighten all lugs to manufacturer’s specifications, and adjust transformer taps to provide secondary voltage to within 2% of nominal system rating.

D. Transformers, whether wall or floor mounted, shall be supported in a manner to reduce the noise level to a minimum. All wall mounted indoor transformers shall be mounted 6 in. minimum from the ceiling.

3.02 FIELD TESTING

A. Measure primary and secondary winding resistance for shorted or open windings.

B. Measure primary and secondary voltages for proper tap settings.

C. Measure impedance from neutral to ground.

D. Submit written report of test results to Engineer.

PART 4 SPECIAL PROVISIONS

4.01 TRANSFORMER SCHEDULE:

A. Transformers shall be identified as to their location, size, voltages, enclosures, and accessories as per the following schedule.

B. The following schedule is intended to aid the Contractor in identifying transformer location and size. It is intended to supplement the Drawings and Specifications and is not guaranteed to be complete. All transformers shown on the drawings shall be furnished and installed by the Contractor whether or not listed in the schedule.

Location	ID Tag	Indoor Outdoor	Size kVA	Primary Voltage	Secondary Voltage	Accessories	Enclosure
BIOFILTER ELECT RM		INDOOR	45 KVA	480	120/208V		1

Accessories:

WS	=	Weather Shield
WMB	=	Wall Mounting Bracket
CMB	=	Ceiling Mounting Bracket

Enclosures:

1	=	NEMA 1
3R	=	NEMA 3R
4X	=	Stainless Steel

END OF SECTION

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SECTION 16510
LIGHTING

PART 1 GENERAL

1.01 SCOPE

A. Under this Section, the Contractor shall provide all labor, material, services, and appurtenances necessary to make a complete operating lighting system.

B. The Work specified in this Section includes but shall not be limited to, furnishing, installing, connecting, and testing lighting fixtures, lamps, hangers, structural supports, wiring, outlets, connections, and controls as shown on the Drawings or specifications.

C. All Work, services, wiring, devices, equipment, and systems described herein shall conform to appropriate Sections of Division 16.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. A list of materials giving manufacturer's name and catalog numbers.

   b. Manufacturer's Literature on lighting photometrics.

2. Information for the Record:

   a. Manufacturer's recommended method of installation for the products to be furnished.

   b. Operation and maintenance manual.

   c. Manufacturer's recommended spare parts list for components and accessories.

   d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

PART 2 PRODUCTS

2.01 LIGHTING FIXTURES

A. All lighting fixtures, exit lighting fixtures and emergency lighting fixtures shall be of the size and type designated in the "Lighting Fixture Schedule" and as indicated on the Drawings.

B. All lighting fixtures shall be equipped with accessories, special finishes, or modifications as required, and with hangers and end caps. Continuous rows of ceiling mounted or stem mounted fluorescent lighting fixtures shall have couplers. Flush mounted lighting fixtures shall be furnished with all mounting accessories required for complete installation in the particular ceiling system involved.

C. All vapor tight and hazardous area fixtures shall include an approved cast iron or malleable box.

D. All recessed lighting fixtures shall be equipped with a suitable gasket to prevent light leakage. Where the specific fixture catalog number or type does not include the gasket, it shall be provided by the Contractor at no additional expense to the Owner.

1. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 Electronic Drivers for LED Devices, Arrays, or Systems. LED drivers shall have a sound rating of A, have a minimum efficiency of 85%, and be rated for a THD of less than 20% at all input voltages.

2. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.

E. LED fixture shall comply with UL Standard 8750 Light Emitting Diode Equipment for use in Lighting Products, IES Standard LM-79 Electrical and Photometric Measurements of Solid-State Lighting Products, IES Standard LM-80 Measuring Lumen Maintenance of LED Light Sources.

1. Provide LED fixtures with a DesignLights Consortium® (DLC) listing, a US Department of Energy (DOE) LED Lighting Facts label, or a US Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.

2. Recessed lighting fixtures shall be thermally protected.

3. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers.

4. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50% - 100%) line voltage, two switch controlled dimming driver.

2.02 LAMPS

A. All lighting fixtures shall be provided with the proper number and types of new lamps of the correct size as shown on the Drawings, as specified, or as required for the particular fixture type. Only the number of lamps required to provide adequate lighting for Work yet to be done in each area and acceptable temporary lighting elsewhere shall be installed at the time lighting fixtures are installed and tested. Remaining lamps are to be installed not more than 10 days prior to acceptance of the project by the Owner.

B. All lamps shall be in working order at the time of final acceptance of the Work by the Owner. All defective lamps shall be replaced until the Work is finally accepted.

C. LED lamps shall have a minimum color temperature of 4000 degrees K, CRI of 80 minimum, and a lumen maintenance L70 rating of 50,000 hours minimum.

2.03 LIGHTING CONTROL, GENERAL

A. In addition to the conduit and wiring, the lighting control systems for the exterior lighting systems, certain indoor lighting systems, entrance ways, vestibules and canopies shall consist of the following components:

1. 120 volt separate mount photoelectric cell units shall be provided and wired as indicated or shown. Units shall be Contractor located for operation free of background light.

2. Photoelectric cell units shall:

   a. Be weatherproof.

   b. Have light level adjustment.

   c. Have 1/2-inch stem mounting with swivel.

   d. Have contacts rated to handle 15 amps of incandescent light at 120 VAC and 8.3 amps of ballast load at 120 VAC.

3. Photoelectric cell units shall be Intermatic K4221, or equal.

4. Exterior LED lighting shall have surge protective devices (SPD) for each luminaire. SPD shall be UL-1499 recognized for all phases.

B. Lighting contactors shall be UL approved and provided as required or shown on the drawings.

1. Lighting contactors shall be installed in NEMA 4X stainless steel enclosures unless noted otherwise on the Drawings.

2. Lighting contactors shall have contacts rated for a minimum 30 amps of ballasted lighting/20 amps of incandescent (tungsten) lighting at 277 VAC (480 VAC if connected 2 poles to load on 1 phase or 3 poles to load on 3 phase circuits). For resistive loads the contacts shall be rated for a minimum of 30 amps at 600 VAC. Contacts shall be normally open unless noted otherwise on the Drawings.

3. Lighting contactors shall be electrically held unless noted otherwise on the Drawings.

4. The coil operating voltage of lighting contactors shall be 120 volts, 60 Hz unless noted otherwise on the Drawings.

5. A HAND-OFF-AUTO selector switch shall be provided in the door of the lighting contactor enclosure. There shall be an extra set of contacts that close when the switch is in the AUTO position for connection to the Plant Control System.
6. The following accessories shall be included with the lighting contactor:
    a. Control circuit fuse.
    b. Control circuit transformer with 2 primary and 1 secondary fuses.
    c. Solid neutral terminal block.
    d. Press-to-test pilot light wired in parallel with the contactor coil.
    e. Lightning arrestor.
    f. 24-hour time clock.
    g. 7-day time clock.
7. Lighting contactors shall be Square D Class 8903 Type L, or equal.

2.04 ROADWAY AND YARD LIGHTING

A. All luminaires for the roadway and yard lighting systems shall be of the sizes and types designated on the Drawings.

B. All luminaires shall be equipped with accessories as required for proper workmanlike installation.

C. All luminaires shall be equipped with the poles as indicated on the Drawings.

D. All pole mounting shall be complete with prefabricated anchor bolt assembly, leveling shims, pole base cover, grounding lug, and reinforced handhole.

2.05 OCCUPANCY SENSOR SYSTEM

A. Occupancy sensors shall have both infrared and ultrasonic detection circuits.

B. Occupancy sensors shall be wall or ceiling mounted as shown on the drawings.

C. Wall-mounted occupancy sensors shall have a 110-degree minimum coverage band.

D. Occupancy sensors and control units shall be UL Listed.

E. Operating temperature range shall be 32 to 104 degrees F with rate of change not exceeding 20 degrees F per hour. Relative humidity range shall be 0% to 95% non-condensing.

F. Once triggered, occupancy sensors shall maintain their ON state for at least 20 minutes. Time delay may be fixed or adjustable.

G. Control units for occupancy sensors shall operate on 120 VAC and provide the required DC voltage and current to at least three sensors.

H. Load capacity of occupancy sensor system shall be 1800 watts incandescent or LED and 2400 watts on 120 VAC ballasts. For higher capacity or loads on multiple circuits, use an expansion relay or lighting contactor.

I. Occupancy sensor system shall be Hubbell ATD1600 series sensors with CU series control unit, or equal.

PART 3 EXECUTION

3.01 LIGHTING FIXTURES

A. All lighting fixtures shall be securely supported with hangers approved for the purpose and the particular ceiling involved. Fixture support methods shall meet the fixture manufacturer's recommendations.

B. Box mounted fixtures shall be mounted directly to the mounting ears of the box.

C. Fixtures shall be supported from structural ceilings or structural supports, not suspended ceiling supports. Fixtures shall not be hung from metal deck.

D. Suspended fixtures shall be suspended by means of rigid conduit stems, not by chains or cords, unless noted otherwise. Wherever the stem length in hazardous locations exceeds 1 ft, lateral bracing shall be provided within 1 foot of the fixture.

E. Fixtures shall be installed with due regard for structural systems, doors, piping, ductwork, and other mechanical equipment and related Work. Any fixture obscured with other Work shall be relocated at the Contractor's expense.

F. Unless the mounting height of fixtures is shown on the Drawings or designated in the Project Specifications, fixtures shall not be mounted less than 9 feet above the floor unless the ceiling height will not permit such height.

G. Job site Conditions: Surfaces and structures to, and on which products will be placed and installed shall be inspected before the Work of this Section begins, and shall be capable of supporting the products. Surfaces which will be concealed by products shall be finished before products are installed. Sources of permanent power shall be connected to products only after the products have been installed, inspected, tested, and approved.

H. Emergency fixtures shall be wired to the same branch lighting circuit as normal fixtures in the same area, but to the line side of any switch or control device.

I. Multiwire, (shared neutral), branch circuits may be used for lighting fixtures containing ballasts when the fixture includes a switch capable of simultaneously opening all supply conductors to the ballast.

J. Provide at least two local disconnecting means for areas served by more than one luminaire containing ballasts. The purpose of this is so no person replacing a ballast will have to work in total darkness. This does not apply to luminaires located in hazardous areas, cord and plug connected luminaires or emergency lighting.

3.02 ROADWAY AND YARD LIGHTING

A. All poles and luminaires shall be assembled and erected in full compliance with manufacturer's recommendations.

B. Trenching and backfilling for electrical work shall be performed as specified in Section 02200.

C. All concrete bases for roadway and yard lighting as indicated on the Drawings shall be furnished and installed under this Contract in a manner as specified in Section 03300 of this Specification.

3.03 OCCUPANCY SENSOR SYSTEMS

A. Occupancy sensor control units shall be installed in NEMA rated enclosures appropriate for the area in which they are to be located.

B. Occupancy sensors shall be mounted on the wall or ceiling in accordance with the drawings and manufacturer's instructions.

3.04 TESTS AND INSPECTIONS

A. General - This Section sets forth the electrical testing procedures required for the acceptance of electrical equipment as described in the sections that follow. The purpose of the specified tests and inspections is to determine that each piece of equipment is in satisfactory condition to successfully perform its intended function. It is the intent of these procedures to ensure that all workmanship, material, the manner and method of erection and installation conform to manufacturer's instructions, IEEE and ANSI standards and NEC, except as modified herein.

B. Responsibility - The Contractor shall perform and supervise all tests unless specifically noted otherwise herein or on the Drawings. The Contractor shall furnish all equipment required for the test performed by him and shall be responsible for providing such safety measures as are required for each test.

1. The Contractor shall schedule all testing with the Engineer and no testing of any kind shall be performed without the Engineer's approval.

2. The Contractor shall notify all involved parties other than the Engineer prior to test, advising them of the test to be performed and the schedule date and time.

3. The Contractor shall give manufacturers sufficient notice to allow the necessary arrangements to be made and to have their engineer or representative present at tests where their presence is required. Where the manufacturer's responsibility includes both electrical and mechanical performance, the Contractor shall coordinate the tests with the others involved.

C. Circuits and Devices - The Contractor shall show by demonstration in service that all circuits and devices are in operating condition.

1. Tests shall be provided to determine that each item of control equipment will function not less than 5 times.
2. The Contractor shall test all 600-volt wiring to verify that no short-circuits or accidental grounds exist. Tests shall be made using an instrument that applies 500 volts between conductor and ground.
3. The conduit system shall be tested for continuity to ground.

3.05 CLEANING

A. Prior to requesting final payment, Contractor shall thoroughly clean lighting fixtures and lamps.

PART 4 SPECIAL PROVISIONS

4.01 FIXTURE SCHEDULE

A. See Drawings for fixture schedule.

4.02 SPARE PARTS

A. Contractor shall furnish at least one spare lamp for each type of light fixture installed. If more than 10 units of a type of fixture are installed, an additional spare lamp shall be furnished for each additional 10 units, or portion thereof, installed.

END OF SECTION

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SECTION 16620
ELECTRIC HEAT TRACING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes furnishing all materials, equipment, labor, and supervision related to electric heating and heat tracing systems necessary for the completion of the Work in accordance with the Contract Documents.

B. All Work performed under this Section shall comply with and be in accordance with all manufacturer's recommendations, and governing codes. Work shall conform to all applicable Sections of Division 16.

C. This Section shall include, but not be limited to, equipment, thermostats, wiring, conduit and fittings, sleeves, inserts, hangers, brackets, supports, required for complete installation.

D. Additional product requirements are specified in Section 01350.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. Manufacturer's technical product sheets on each component to be furnished.

   b. A list of materials needed for construction giving manufacturer's name and catalog numbers.

2. Information for the Record:

   a. Certification of installation by the Contractor that the system has been installed and adjusted for proper operation.

   b. Operation and maintenance manuals.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall furnish and install heat tracing cables and thermostats at the locations shown on the Drawings.

B. The heat tracing cable shall meet or exceed the watts-per-foot specified. The heat tracing cable shall be self-regulating.

C. Valves, flanges, hangers, pipe supports requiring additional heat, shall be wrapped with additional cable in accordance with the manufacturer's recommendations. The minimum length of cable shall be as follows:

1. Flanges - two times the distance from pipe to outer edge of flange.
2. Pipe Supports - two times the pipe support length plus one-half foot.
3. Valves - in feet.

Size (in.)	Screwed	Flanged	Wafer Butterfly
1/2	0.5	1.0	0.0
3/4	0.75	1.5	0.0
1	1.0	2.0	1.0
1-1/2	1.5	2.0	1.5
2	2.0	2.5	2.0
2-1/2		3.0	2.5
3		3.5	2.5
4		5.0	3.0
6		8.0	3.6
8		11.0	4.0
10		14.0	4.0
12		16.5	5.0
14		19.5	5.5

D. All heat tracing cable installed on plastic pipe shall have a maximum maintenance temperature rating of 150 degrees F or less. Tracing cable on plastic pipe 1-inch and larger shall have a strip of 3 mil aluminum foil installed both under and over the cable.

E. The heat tracing cable shall be designed for 120-volt service. The cable shall consist of a flat self-regulating semi-conductive core with a thermoplastic rubber jacket, a tinned copper shield between the inner and outer jacket, and an outer jacket of thermoplastic rubber. Cable shall be manufactured by Accutron, Cooperheat Type GP, Chemelex, Thermo, or equal. All components shall be FM or CSA approved.

F. Ambient and process control thermostats shall be remote bulb type suitable for outdoor mounting. Thermostats shall have a minimum rating of 8 amps at 120 volts. Thermostats shall have a control range of 15-140 degrees F with a fixed differential of 1 degree F. Bulbs shall be installed on pipe under insulation per heat tracing cable manufacturer's recommendations at the locations shown on the Drawings.

1. Thermostats for ordinary class areas shall be Tradeline Model T67A1136 with Q615A weatherproof enclosure as manufactured by Honeywell Inc. or equal. An outdoor glow indicator lamp shall be connected to each thermostat providing visual indication of heating.
2. Thermostats for hazardous areas shall be Raychem E017 series for sensors in ambient conditions.
3. Thermostats for hazardous areas shall be Raychem E5075 for process control.

G. Each major pipe length shall have individual control and limit thermostats.

H. Heat tracing shall begin 3 feet - 6 inches below grade for all pipe which extends above the ground surface.

PART 3 EXECUTION

3.01 COORDINATION

A. Prior to the installation of pipe insulation or concealment of heat tracing, the heat tracing installation shall be tested.

B. The installation of heat tracing is subject to the Owner's approval.

3.02 INSTALLATION

A. Heat Tracing

1. Shall be installed per manufacturer's instructions.

2. Installation shall be tested by contractor and accepted by the Owner prior to insulation installation.

PART 4 SPECIAL PROVISIONS

4.01 SCHEDULES

A. The following schedule is intended to aid the contractor in identifying heat tracing location and size. It is intended to supplement the Drawings and Specifications and is not guaranteed to be complete. All heat tracing shown on the drawings shall be furnished and installed by the Contractor whether or not listed in the schedule.

B. Proprietary Chemical/Water mixture.

C. Pipe Heat Tracing

PIPE HEAT TRACING (HT -)									
Mark Number	**Fluid**	**W/ft**	**Operating Load kVA**	**Pipe Size**	**Pipe Mat'l**	**Actual Pipe Length**	**Pipe Instruments**	**Associated Process Equipment**	**Hazardous**
HT1A	See 4.01B	8w/ft	200	2"	PVC	25'	Press/Flow	BF210	No
HT1B	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF210	No
HT1C	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF210	No
HT2A	See 4.01B	8w/ft	200	2"	PVC	25'	Press/Flow	BF220	No
HT2B	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF220	No
HT2C	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF220	No
HT3A	See 4.01B	8w/ft	200	2"	PVC	25'	Press/Flow	BF230	No
HT3B	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF230	No
HT3C	See 4.01B	8w/ft	200	1 ½"	PVC	25'	Press/Flow	BF230	No

END OF SECTION

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SECTION 16901
MONITORING AND CONTROL SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work under this Section and all subsequent sections encompasses and governs the design, fabrication, installation, commissioning, and testing as required to place into operation the instrumentation and control systems for all facilities provided under this Contract. The instrumentation and control systems and Plant Control Systems (PCS) shall hereinafter be referred to as the monitoring and control system.

B. The requirements of this Section are complimentary to all sections of this Division 16 and the requirements herein shall apply to all sections of this Division 16.

C. Certain control components will be furnished and installed under other sections. These components shall be wired and incorporated into the monitoring and control system. These components are described in the Contract Documents for the respective sections and shall include but not be limited to the equipment in Division 11.

D. All piping and valves for connecting field instruments shall be furnished and installed as specified under Section 16902 or as required.

E. The Contractor shall be responsible for the detailed engineering design and furnishing and installation of all control components, as required so that the completed installation of the control system is in accordance with the performance and functional requirements of the Contract Documents.

F. All control components shall be installed, placed into service, and calibrated in accordance with the component manufacturer's recommended application, installation, and operational procedures. The Contractor shall be responsible for providing control components and/or interface equipment to allow the control components to function as intended by their manufacturer.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 and shall include.

1. Shop drawings for review:

a. All Drawings, without exception, of all schematics, diagrams, and drawings for instrumentation and/or electrical control systems, shall be 17-inch-wide and 11-inch-high or 36-inch-wide and 24 inch high. All lettering shall be block type. Nomenclature describing the system shall be located in the lower right corner and immediately above the system description shall be left blank for routing and approval references by the

Engineer. AutoCAD Version 2006 compatible electronic files of each drawing shall be provided upon approval of as-built drawings.

b. Electrical drawings including elementary (schematic) diagrams, field and panel interconnection diagrams, block diagrams, panel layouts, stock lists, and sequence of operation shall be prepared for all control circuits indicated on the P&ID. The diagrams shall be in accordance with NFPA 79, Annex D. Additionally, all Contractor assigned ISA tag numbers must be shown in conjunction with device numbers. Each schematic shall be individually labeled. All instrumentation and control wires shall be individually labeled and conform to the terminal designations within their control panels. Interconnecting wire number shall be coordinated by the Contractor. Where practical, wire numbers will be unique and continuous. If wire numbers change during interconnection of equipment to equipment, the individual equipment schematics will have both wire numbers and destinations noted at point of transition.

c. Instrument loop diagrams shall be prepared and submitted for all digital and analog control circuits of the control system. The loop diagrams shall be in accordance with Standard S5.4 as published by ISA. The instrument loop diagram format shall be as described in the Standard. The instrument loop diagram symbols shall be as described in the Standard except for the modifications shown on the Contract Drawings.

d. A loop and/or point identification numbering system shall be developed to best suit the total monitoring and control system documentation. The numbering system shall be subject to review and modification by the Engineer.

e. Submittals supplied by, though not created by, the Contractor shall conform to this Specification and shall bear evidence of the Contractor's approval.

f. Manufacturer's specifications complete with descriptive information indicating design data underscored to assist in verification that proposed equipment is equal to or exceeds the technical requirements and intent of these Specifications.

g. Dimensional outline drawings of all control and instrument enclosures, including designated conduit or wireway entrances, and internal equipment layout drawings including construction details necessary for fabrication, shall be prepared and submitted.

h. The Contractor shall provide the addressing of the PCS I/O points to the programmable controller within 45 days of the Engineer's approval of the PCS. The addressing and wire numbers as approved by the Engineer shall be used as the basis of the Contractor's wire and terminal numbering system.

2. Information for the record:

   a. Upon completion of the installation and acceptance by the Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, instrument loop diagrams, and related support material shall be corrected and amended, as required, to reflect the installed system. A computer file on disk for each document listed above shall be provided to the Engineer in a format compatible with the latest version of AutoCAD, after having been accepted and corrected to reflect as-built conditions. A complete set of 24 inch by 36 inch plots of each document shall accompany the computer files.

   b. A set of the Instrumentation and Control Drawings shall be marked to reflect the installed control system and shall include the programmable controller memory locations shown for each I/O point.

   c. The Contractor shall submit operation and maintenance manuals in accordance with Section 01300.

1.03 GUARANTEE

A. The Contractor shall assume the primary responsibility for all equipment furnished and supplied under the Contract Documents and shall provide a written certification that the equipment items are:

   1. Designed to be utilized for the operations described in the Contract Documents and vendor certified to perform the intended operations.

   2. Guaranteed and warranted, without exception, for a period of not less than 12 months from the date of substantial completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Products for the monitoring and control system shall be as specified in Sections 16902, 16903, 16905, and 16910.

B. To minimize maintenance problems, spare parts inventory and to assure compatibility of control components with control system requirements all similar type of control components shall, to the extent possible, be acquired from a single manufacturer.

PART 3 EXECUTION

3.01 COORDINATION

A. The execution of the PCS shall consist of the installation and commissioning of all equipment included as part of the monitoring and control system.

B. Installation of the monitoring and control system shall be in accordance with the published installation and operation manuals of the manufacturers, and as described elsewhere in these Specifications. Commissioning of the PCS shall be as described below.

3.02 PRE-COMMISSIONING

A. The Contractor shall be responsible for all installation. After the equipment has been installed, the Contractor shall make all adjustments necessary to place the system in trouble-free operation and instruct the plant personnel in the proper service and operation of the equipment furnished.

B. The Contractor shall file with the Engineer a certificate stating that the equipment has been installed in accordance with the manufacturer's recommendations and that trial operation is satisfactory prior to start of field testing.

C. When necessary to comply with the manufacturer's installation requirements, the Contractor shall provide the services of the equipment manufacturer's factory trained personnel for the supervision of installation, placing into service, and calibration of equipment.

D. Conduit and wiring for signal and control circuits between the programmable controller I/O systems and field devices, motor control centers, control panels, and process equipment shall be in accordance with Section 16010.

E. The Contractor shall provide equipment to interface the programmable controller I/O systems with field devices, motor control centers, control panels, and process equipment whether existing or supplied under this or other Divisions of the Work. All interface requirements shall be engineered, installed, tested, and documented by the Contractor.

F. The Contractor shall maintain a neatly marked set of record as-built drawings showing the installed location and routing, instrument tubing runs, instrumentation cable runs and, where necessary, air supply piping back to nearest header. In addition, he shall show the locations of panels, field mounted instruments and panels, control valves, terminal boxes, junction boxes, and any other components for which he is responsible. Drawings shall be kept current with the Work as it progresses and shall be subject to inspection by the Engineer at any time.

3.03 COMMISSIONING

A. The monitoring and control system commissioning effort shall be completed by the Contractor with the schedule approved by the Owner and Engineer. The Owner and Engineer shall have the option of witnessing the procedures if they prefer to. The Contractor shall, as a minimum, complete the following procedures as part of the commissioning effort:

1. Completely check all control loops in the presence of the Engineer/Owner. Loops shall be defined as, but not limited to:
    a. Motor control center logic.
    b. Local control logic.
    c. Analog control logic.
    d. Discrete input to the programmable controller.
    e. Analog input to the programmable controller.
    f. Discrete output from the programmable controller.
    g. Analog output from the programmable controller.
    h. All control loops shall be checked for ground fault potential.
2. Upon verification of wiring, the Contractor shall perform the following “hot tests”.
    a. All analog devices shall be set and calibrated to the appropriate points. That is the zero, span, etc., shall be set and tuning pots sealed upon completion.
    b. All analog devices shall be measured at all points of termination at the following ranges 0%, 25%, 50%, 75%, 100%, with actual measured value recorded in addition to calculated expected value.
    c. All discrete switch points to be verified per selected settings including deadband resets.
    d. All devices shall be checked that correct device, model number, range, etc., is provided.
    e. All loops shall be measured for correct voltage AC and appropriate voltage level on DC power supply.
    f. All local control logic shall be energized and checked by forcing process conditions to set points to assure proper shutdown by safety devices.
    g. All local pushbutton stations shall be exercised to assure functioning of local devices.
    h. All discrete indication to the programmable controller system and operator interface system shall be checked to appropriate I/O point and all indication of such points on all operator interface displays.
    i. All analog systems shall be forced by process conditions through the range as specified to check response from the element through the programmable controller and operator interface system.
    j. Upon an incorrect or absent signal, either discrete or analog signal to the programmable controller/interface system, the Contractor shall

measure the signal starting at the primary element and continuing through each junction to identify where loss of signal occurs.

k. All incoming analog signals and discrete signals to the programmable controller system shall be measured at the termination point in the programmable controller panel and the values recorded.

3. Programmable controller/operator interface outputs to field elements shall be tested in the following manner:

   a. All discrete outputs shall be forced manually through the operator interface. Each field device shall be measured for correct voltage and fully motion checked. That is valves fully stroked, motors run to prove operation.

   b. All discrete outputs shall be stopped by local stop button. Local stops shall be then reset to assure programmable controller logic properly reset and equipment does not self-restart.

   c. All analog outputs shall be forced through the operator interface at each level 0%, 25%, 50%, 75%, and 100%. At each level, the signal shall be measured at each device in the loop and this measured value recorded through the final field element.

4. Documentation necessary at commissioning effort:

   a. Complete elementary schematics for all control logic, MCC logic, P&IDs, etc.

   b. Complete wiring diagrams for all control panels, MCC, etc.

   c. Complete interconnect diagrams for all field wiring.

   d. Complete loop diagrams for all analog loops in the PCS.

   e. Complete hardware operation and maintenance manuals for all elements in the PCS.

   f. Complete calibration sheets for all field and panel devices.

   g. Complete sequence of operation manual as required per Specifications.

5. Hardware necessary for commissioning effort:

   a. All field elements, panels, etc., installed and wired.

   b. All necessary spare parts for the project on-site, accepted and inventoried.

   c. Instruments as necessary to measure and debug systems to be supplied by Contractor including translation units, VOM multimeters, signal generators, etc.

d. The Contractor shall provide all necessary devices to force process conditions through the full range and set point of the primary element devices.

6. Personnel necessary for commissioning:

   a. The Contractor shall provide adequate personnel to fully test and commission all points in detail as described.

   b. The Engineer/Owner will provide adequate personnel to observe, monitor, and verify the commissioning effort of the Contractor.

   c. It shall be the Contractor's decision to suspend the commissioning effort to correct problems encountered. The Contractor shall notify the Engineer/Owner in writing 24 hours in advance of resumption of commissioning efforts.

7. Record maintenance of commissioning:

   a. The acceptance of correct information shall be yellowed out on sets of documentation as previously described. All information or data found incorrect shall be identified on all documentation in red and yellowed out when verification has been completed.

   b. The Contractor shall provide the following sets of documentation for the commissioning effort:

      1) One set for the Owner's personnel.

      2) One set for the Engineer's records.

      3) Required number of sets for Contractor.

      4) Two sets for field use.

   c. At the conclusion of each day, the Contractor shall mark all sets of documentation to agree with the field sets to assure information is up to date. This shall be done in the presence of the Engineer/Owner.

   d. All points shall be commissioned in the commissioning effort regardless of use by the Owner and so identified.

   e. Completion and correction of all loops both discrete and analog of a given subsystem with satisfactory documentation completes the commissioning efforts for the subsystem. The commission effort for the monitoring and control system shall not be considered complete until all subsystems are completed.

   f. Documentation of commissioning shall identify correctly all terminal numbers, wire numbers, device type, model, range, set points, measure responses, etc., on all appropriate drawings, forms, etc., whether information is a duplication or not. The final complete documentation

of the commissioning effort shall form the basis of the as-built requirements for the contract documents.

8. Schedule for commissioning:

   a. Commissioning can begin only when all required hardware, hard copy, and documentation is in place.

   b. A schedule in detail for commissioning shall be submitted to the Engineer/Owner for review and comment prior to the commission effort.

   c. The Contractor shall submit, for approval, the schedule for all training activities required by the Contract Documents. Individuals involved in commissioning and/or field testing cannot concurrently be involved in training activities, etc.

   d. The Contractor's commissioning efforts shall be organized to allow completion of systems in their whole form. This will eliminate returning to areas which can be completed.

PART 4 SPECIAL PROVISIONS

4.01 ISA CODE (MODIFIED)

A. The instrument identification nomenclature shown on the Drawings shall be used in the development and coding of all devices shown on the P&ID. The ISA Code has been modified from the suggested standard for this facility and shall be strictly applied. When the "/" is used, it signifies that two letters from the same column are used (i.e., a current to current transmitter would be shown as I/IT).

B. The symbol identification shown on the Drawings shall be used in the development and coding of devices shown on the P&ID.

END OF SECTION

SECTION 16902
METERING AND CONTROL EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. Work under this Section includes furnishing and installing all metering and control equipment which is part of the Plant Control System including the Blower Building Master PLC programmable controller system and the graphic user interface system.

B. All Work performed shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

a. Manufacturer's literature including model number, type, size, materials, quantity, connections, equipment number, mounting hardware, and installation information.

2. Information for the Record:

a. Equipment suppliers report that equipment is properly installed and satisfactory operation is obtained.

b. Software, cables, etc. for configuration, programming or operation of meters or equipment, minimum of two each is required.

c. Operation and maintenance manuals.

d. Schedule of Owner's training for all new equipment.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. All metering and control equipment shall be as indicated on the Drawings and as specified, and shall include, but not be limited to those devices hereinafter defined. Should additional devices be required, but not specifically indicated elsewhere, in order to affect the intent of the Contract Documents, such devices shall be furnished.

B. All metering and control equipment used for similar applications shall be the product of a single manufacturer.

C. All features and requirements listed in the individual instrument specifications are required.

D. All field instrument enclosures shall be NEMA 4X construction except in hazardous locations where the enclosures shall be NEMA 7 for Class I, Division 1, Group D service, unless otherwise noted. Equipment in hazardous locations shall indicate temperature rating as specified in the NEC.

E. All faces of panel mounted instruments shall be NEMA 4X construction except where the panel is located in a protected Control Room environment.

F. Whenever an "or equal" equipment item is proposed in lieu of that specified it will not be considered equal if it is of non-potted construction and the specified item is potted construction.

2.02 PERFORMANCE REQUIREMENTS

A. Intrinsically safe equipment shall be Factory Mutual approved for Class I, Division 1, Group D service.

B. Analog signals for input to a programmable controller system shall be isolated 4-20 mA DC and where required, current to current transducers or other device shall be furnished to produce an isolated signal to the programmable controller analog input modules.

C. Digital input signal sources shall provide an isolated contact rated at 5-amp minimum, 115 VAC, to the programmable controller system.

D. Power supplies shall be furnished for two-wire transmitters and other devices requiring DC power. No more than four loops shall be powered from one power supply. Separate power supplies shall be provided for duplicate instruments to ensure failure of one power supply will not inhibit operation of secondary equipment.

E. The Site is in an area subject to radio frequency activity. Any equipment sensitive to radio frequency interference (RFI) shall be provided with the proper RFI filters, be properly shielded and grounded, or otherwise protected to allow proper operation of the equipment.

2.03 POWER AND POWER CONDITIONING

A. Instrument Power Supply

Function:	Power for up to six 4-20 mADC signal loops. If more than six loops, use additional units of the same size.
Type:	Electronic Solid State
Input:	120 VAC, 60 Hz
Output:	As required, +/- 1 VDC adjustable
Load:	Load +/-0.05%, Line +/- 0.05%
Ripple and Noise:	0.5 mv RMS
Mounting:	Plug-in with octal base and screw terminals.

Features:	Overvoltage protection
Manufacturer:	Acopian
	V"x"J Series ("x" is required output voltage), or equal

2.04 SIGNAL CONDITIONING

A. Relay ((EY))

Function:	Logic Control
Type:	General Purpose (plug-in octal base)
Contacts:	120 volt 60 Hz, 10 amps, DPDT
Coil Voltage:	120 volt, 60 Hz, with LED indicator
Mounting:	Plug in 8 pin with screw terminals
Manufacturer:	Allen-Bradley
Model:	700-HA32A1-4 with 700-HN125 socket, or 700-HN202 socket with 700-HS surge suppressor as required, or equal

B. Relay ((EY))

Function:	Logic Control
Type:	General Purpose (plug in octal base)
Contacts:	120 VAC, 60 Hz, 10 amps, DPDT
Coil Voltage:	24 VDC, with LED indicator
Mounting:	Plug-in 8 pin socket w/screw terminals
Manufacturer:	Allen Bradley
Model:	700-HA32Z24-4 with 700-HN125 socket, or equal

C. Relay ((EY))

Function:	Logic Control
Type:	Machine Tool
Contacts:	Replaceable Cartridge
	4 or 12 pole (NO or NC)
	600 volt, 60 Hz Rated - 10 amps
Coil Voltage:	120 volt, 60 Hz
Surge Suppressors:	Provide on all PLC controlled relays
Mounting:	Suitable for control panel subplate or track mounting
Manufacturer:	Allen-Bradley
Model:	700P with 700-N surge suppressor as required, or equal

2.05 RESERVED

2.06 RESERVED

2.07 RESERVED

2.08 RESERVED

2.09 RESERVED

2.10 POSITION

A. Position Switch ((ZS))

Function:	Indicate roll-up door is open
Type:	Magnetic switch
Switch:	Reed switch w/ deactivated rhodium on gold underplating
Enclosure Rating:	NEMA 6P continuous submergence
Cable:	61 cm armored cable
Accessories:	Contact switch, Magnet w/bracket
Manufacturer:	SECO
Model:	Seco-Larm SM-226R-3Q

B. Intrusion Switch ((ZS))

Function:	Indicate door not closed
Type:	Magnetic, having a minimum of two hermetically sealed reed contacts
Switch Contacts:	SPDT, Form C, closed when door is closed rated at 24VDC
Consumption:	3W max
Enclosure:	Completely encapsulated within high strength aluminum housing, moisture and corrosion resistant, rated for Class I Group B when located below grade or for hazardous location
Mounting:	Screw terminals, screw mounting
Accessories:	Interface/isolation relays as required
Manufacturer:	GE Interlogix/Sentrol
Model:	2500 Series, 2800T Series, or equal

2.11 RESERVED

2.12 ANALYTICAL

A. Gas Monitor ((AE)/(AIT))

Function:	Measure gas concentration and transmit signal proportional to concentration level
Gas Types:	Combustibles, oxygen, toxics, as shown in schedule
Temperature Range:	
Combustibles:	-40 to 140 degrees F
Oxygen and Toxics:	-40 to 140 degrees F
Output Signal:	4-20 mA, 600 ohm max load resistance
	Warning, alarm, and fault, 5A SPST relay contacts
Display:	LCD display indicating gas concentration, sensor status

Zero Drift:	< 5%/year
Span Drift:	< 10%/year
Linearity:	
Combustibles:	+/- 3% at < 50% LEL, +/- 5% at > 50% LEL
Oxygen	+/- 2% of full scale
Hydrogen Sulfide:	+/- 10% of full scale
Repeatability:	+/- 1% of full scale
Response Time:	
Methane/Combustibles:	< 8 sec to reach 50% of scale
Toxics:	< 30 sec to reach 50% of scale
Sensor Life:	
Combustibles:	5 years, typical
Toxics:	5 years, typical
Power Requirements:	24 VDC
Enclosure:	NEMA 4X, explosion-proof as required
Program Access:	Password protected integral keypad, or Bluetooth interface with Android and Apple App
Accessories:	Provide 1 calibration kit. Should include all gasses, hoses, regulators, etc. to perform calibration of gas detectors.
Manufacturer:	MSA, or equal
Model:	Ultima X

B. Gas Monitor, Alarm, and Controller ((AE)/(AIT))

Function:	Measure and display gas concentrations, audibly and visually indicate alarms, transmit signals indicating alarm status and signals proportional to concentration levels
Gas Types:	Combustibles, toxics, as shown in schedule
Temperature Range:	+14 to 122 degrees F
Input:	1 to 8 channels, as required
Output Signal:	4-20 mA, 250 ohm max load resistance
	5 SPDT 2A, 250 VAC relay contacts per channel, including four programmable alarm relays and one fault relay
	Audible alarm
Display:	LCD display indicating gas concentration, alarm and fault status LEDs, for each channel
Power Requirements:	120 VAC
Enclosure:	
Controller:	NEMA 4
Sensors:	NEMA 4X, explosion-proof as required
Manufacturer:	MSA, or equal
Model:	Gasgard XL controller and Ultima X sensors

2.13 ACCESSORIES

A. All piping and tubing for connections to instruments shall be stainless steel. Threaded pipe shall be ASTM A312, Grade TP304, Schedule 40S, and fittings shall be AISI Type 304.

Tubing shall be ASTM Grade TP304, 0.028-inch minimum wall thickness for flareless "bite" type with threaded nut and ferrule fittings.

B. Valves shall be stainless steel eccentric plug valves with a bolted-on non-removable lever actuator. Valves shall be equal to DeZuric Figure 130 with synthetic rubber faced plugs. Valves shall have screwed or flanged ends as required. Valves for gas service shall be designed for gas service and shall provide leak-proof shutoff.

C. Diaphragm seals shall provide continuous isolation between pressure gauges, switches, and transmitters from process fluid. Upon instrument removal or failure, there shall be no leakage. Seals shall be of the type to allow instrument and diaphragm top housing to be removed from the process piping with no leakage of process fluid. Seal fill fluid shall be incompressible, non-corrosive, and suitable for materials of construction and temperature encountered, and shall be selected to minimize temperature effect. Sludge piping process connections shall be 1-1/2-inch, 150 pound flanged. Gas and water piping process connections shall be 3/4-inch NPT. All instrument piping connections shall be 1/2-inch or 1/4-inch NPT, as required. All process connections shall have a 1/4-inch NPT flushing connection with a 316 SS plug.

D. All mechanical fasteners such as bolts, nuts, screws, cinch anchors, clamps, etc., shall be stainless steel.

E. All special mounting brackets shall be stainless steel, galvanized, or nonferrous non-corrosive metal.

F. All equipment mounted outdoors that includes any type of visual indicator, LCD, etc., shall be furnished with a sun visor.

G. All equipment located outdoors shall include a thermostatically controlled space heater.

H. All field instruments and devices shall be equipped with a 1-inch x 3-inch stainless steel identification tag firmly affixed to the instrument or device with stainless steel fasteners. Each tag shall show the manufacturer's name, serial number, part number, tag number (to be approved by the Engineer), calibrated ranges, or calibration constants.

I. For each type of device installed, the Contractor shall supply two complete sets of software, hardware, calibration devices, and cabling, used to configure, calibrate, or make adjustments.

PART 3 EXECUTION

3.01 GENERAL

A. The features and installation of the instrumentation shall be coordinated for optimal performance with the characteristics of the process material to be metered.

B. Care must be exercised to identify locations that meet the requirements of the manufacturer including upstream and downstream distances, pressures, temperatures, and accessibility for maintenance.

C. Verify equipment requirements and dimensions with provisions specified under this Section. Check actual field conditions, report necessary changes, and submit equipment reflecting changes.

D. Coordinate Work with other trades to avoid conflict and to provide correct rough-in and electrical connection requirements. Inform Contractors of other trades of the required access to and clearances around equipment to maintain serviceability and code compliance.

E. Where the installation of any device is dependent on, or affected by, Work performed under other sections of these specifications, the Contractor shall coordinate the Work. Installation coordination includes the correct location and placement of devices, piping to the equipment, pipe taps, control power circuits, connections to the control system, etc.

F. Installation of instrumentation in an existing system being modified, replaced, or abandoned, shall be coordinated with the Owner and shall be performed to minimize operational disruptions and minimize time that equipment may be out of service.

3.02 INSTALLATION

A. Installation shall include the provision of materials, and the coordination of all details, necessary to properly install the instruments including location, arrangement in piping, power source, signal wiring and conduit, special brackets, and all mounting hardware.

B. All instrumentation devices shall be installed in accordance with the manufacturer's installation requirements.

C. Wiring practices for intrinsically safe systems shall be in accordance with ISA RP12.06.01.

D. Instruments shall be installed so that the various components are accessible for maintenance. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment, including piping, for ease of removal and servicing. All instruments shall be readily accessible from grade, permanent platforms, or fixed ladders.

3.03 STARTUP AND TRAINING

A. The Contractor shall provide the services of component manufacturer's factory trained personnel for the supervision of installation, initialization, and calibration of equipment.

1. These services shall also include a minimum of one eight-hour day to instruct the Owner's personnel in the operation and maintenance of the equipment. Specifically, these services shall be provided for but not limited to the following equipment items: All new equipment that is provided by Contractor.

Specification Subsection	Description
2.12 A,B	Gas Detection System

PART 4 SPECIAL PROVISIONS

4.01 GENERAL

A. Schedules included herein are intended to supplement the Drawings and are not guaranteed to be complete. All instrumentation devices shown in the Contract Documents or otherwise required to complete the Work shall be furnished and installed.

4.02 ANALYTICAL INSTRUMENT SCHEDULE

A. The following schedule is a listing of analytical devices including: gas detection, chlorine residual monitors, turbidity, etc.

B. The following letter designations are used in the schedule:

Item Designation:

AIT-1	First Letter	A	=	Indicates Analytical Device
	Second Letter	I	=	Function, Indicator
	Third Letter	T	=	Function, Transmitter
	Number	1	=	Item Number

Function:

C	Controller
S	Switch
I	Indicator
T	Transmitter

C. Analytical instruments are numbered on the Drawings and scheduled as follows:

Item No.	Function	Range	Power Supply	NEMA Rating	Dwg No	Spec No.
Gas Detect. CP	Controller		120V	4X	E-4	2.12A
CH4 Sensor	Transmitter		24VDC	4X	E-4	2.12B
H2S Sensor	Transmitter		24VDC	4X	E-4	2.12B
Comb. Sensor	Transmitter		24VDC	4X	E-4	2.12B

4.03 SPARE PARTS

A. The Contractor shall furnish spare parts as shown in the Spare Parts Schedule. The spare parts shall be individually packaged for protection against dirt and moisture. Each package shall be labeled as to its contents with a description and part number.

B. All spare parts shall become the property of the Owner. The Contractor shall maintain the spare parts inventory level as shown in the Spare Parts Schedule, and replace at no cost to the Owner all spare parts consumed during the one-year warranty period.

4.04 SPARE PARTS SCHEDULE

A. Specification

Subsection Number	Description	Quantity	Remarks

B. Where a unit is indicated it shall be a complete unit as specified herein and installed including enclosure.

END OF SECTION

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SECTION 16905
PROGRAMMABLE CONTROLLER SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work under this Section includes programmable controllers and accessories to be furnished and installed as part of the Programmable Controller System (PCS).

B. The programmable controller hardware installed shall perform process control and data acquisition.

C. The PCS shall consist of Ethernet compatible PLC's, located in the control panels and as shown on the Drawings, including all component interconnections and network connections.

D. All programmable controllers provided as part of this Work, including those provided under Division 11, shall meet the requirements of these specifications, and shall be directly integrated as a part of the plant control system Ethernet network without additional communication hardware or software communication drivers.

E. The Contractor shall furnish all labor, tools, equipment, and materials necessary to furnish and install the PCS in accordance with the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submittals shall be in accordance with requirements of Section 01300 and shall include:

1. Shop drawings for review

a. Materials list identifying quantities, manufacturer's name, and catalog number for each device.

b. Manufacturer's data sheets for all equipment indicating model numbers, serial numbers, and a detail of each component.

c. Addressing of the PCS I/O points shall be provided within 60 days of the Engineer's approval of the PCS. The addressing and wire numbers, as approved by the Engineer, shall be used as the basis of the Contractor's wire and terminal numbering system.

d. Wiring diagrams showing connections for all equipment furnished under this Section.

1) Control schematics for each I/O point shall identify the module, terminal designations, and individual wiring numbers.

2) A system block diagram shall be furnished and shall show hardware layout, all hardware interconnections, connection type and cabling.

3) Programmable controller control panel schematics shall include all internal device interconnections.

e. Scaled drawings for each control panel having programmable controller hardware installed within, showing layout of control panel interior and exterior, including overall dimensions, voltage rating within wire ducts, and panel mounting.

2. Information for the record

a. Drawings revised and approved per the installed and tested system.

b. Operation and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.

B. Equipment and material shall be furnished by a manufacturer that has had an installed base of similar equipment for a minimum of the past five years. Equipment shall be of top quality construction and design, and shall be guaranteed to perform the service required.

C. Applicable Standards:

1. NEC.

2. UL.

3. NEMA.

4. NFPA.

1.04 ELECTRICAL AND CONTROL COORDINATION

A. The provision and installation of PCS hardware that interfaces with other devices not provided under this Section shall be coordinated to ensure compatibility between the control hardware and other devices. This includes checking signal type and device rating for existing and new instruments during installation to confirm actual connections. The coordinated installation shall include the provision of appropriate modules and ancillary devices recommended by the control hardware or device manufacturer.

B. The power source for the PCS will be from power circuits shown on the Drawings. The Contractor shall be responsible for furnishing and installing a constant voltage filtering transformer of sufficient size for the programmable controller and its associated input

devices and modules. The constant voltage transformer provided shall be in accordance with the uninterruptible power supply requirements described herein.

1.05 PRODUCT HANDLING

A. Deliver all programmable controller equipment installed in the enclosure(s) and properly packaged in manufacturer's original containers, including wrappings, to properly protect devices from damage.

B. Store programmable controller equipment in manufacturer's furnished packaging and protect from weather and construction traffic. Store indoors and within a temperature controlled area. Never store outdoors.

C. Handle programmable controller equipment carefully to prevent physical damage. Do not install damaged equipment. Damaged equipment shall be removed from Site and replaced with new equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. The PCS shall be a complete operating system including: a central control processor, memory modules, main chassis, expansion chassis as required, appropriate interface and communication modules, input and output modules, power supplies, and interconnection cabling.

B. Each PCS shall be provided with I/O modules to accommodate all input and output signals included as part of this Work, necessary to meet the operational requirements, and as shown on the Drawings, including indicated future I/O points, plus an additional 25% spares for each type of signal used in the chassis. Chassis size shall be selected to accommodate all of the required I/O modules plus 25% spare slots with a minimum of two spare slots.

C. Equipment and catalog references in this Specification refer to a PCS as manufactured by Allen-Bradley. The Contractor shall furnish the programmable control system hardware specified.

D. Where required, interposing relays shall be provided for inductive loads greater than the capability of the digital output modules. Where required to eliminate the effects of electrical interference for inductive AC devices such as relays, solenoids, motor starters, small motors and the like, surge suppressors shall be provided and installed at the devices.

E. Circuit breakers shall be provided and installed for input isolation as recommended by the manufacturer and as required herein.

2.02 MAIN PROGRAMMABLE CONTROLLER HARDWARE

A. Programmable controller hardware shall be provided and installed as shown on the Drawings and described herein.

B. The main control processor shall provide monitoring and control for all devices as shown on the Drawings.

C. All cables and connectors necessary to provide required interfacing shall be provided.

D. Minimum requirements are as shown in the following listing:

Module Description	Allen-Bradley Catalog No.	Remarks
Processor	1769-L30ER or L33ER	CompactLogix 5370 L3 processor, dual port integrated Ethernet/IP, 1 MB minimum
Memory Module	1784-SD	1 GB memory card
Power Supply	1769-PA4	Quantities as required
Communication Expansion Cable	1769-CRx	Quantities as required
Digital Input Card	1769-IA8I	8 individually isolated 120 VAC digital inputs, quantities as required
Digital Input Card	1769-IQ16	16 general purpose 24 VDC inputs, quantities as required
Digital Output Card	1769-OW8I	8 isolated AC outputs, quantities as required
Analog Input Card	1769-IF4I	4 differential inputs, 4-20 mA, individually isolated, quantities as required
Analog Output Card	1769-OF4CI	4 current outputs, individually isolated, analog outputs, quantities as required
End cap	1769-ECR, ECL	End cap, quantities as required
Battery	1769-BA	Quantities as required
Serial Cable	1756-CP3	RS-232 serial cable, quantities as required

E. No single processor module or communication module shall serve as interface for more than one radio communication device. Communication interface modules shall be provided for each radio communication device connection to ensure communication link redundancy. Interface modules shall be control processor backplane compatible, with two DF1 Full/Half Duplex Master/Slave ports, and a separate RS232 configuration port. Communication interface modules shall be ProSoft Technology MVI56-DFCM.RESERVED

2.03 RESERVED

2.04 PROGRAMMING SOFTWARE

A. Provide two copies of the current English version of programming software for each type of processor provided. Software shall be RSLogix Studio 5000 Designer and RSLinx OEM (9355-WABOEMENE).

B. One copy of each type of programming software shall be licensed to the Owner, and one copy of each type of programming software shall be licensed to the Owner's designated systems Integrator.

C. Each software package shall include programming cables and one year of manufacturer's support service and warranty.

2.05 POWER REGULATION AND BACKUP POWER SUPPLY

A. Uninterruptible power supplies shall include protective regulation and shall provide uninterruptible power for all designated devices simultaneously. Each uninterruptible power supply shall be sufficiently sized to provide battery packed power for 60 minutes upon complete power failure.

B. Uninterruptible power supplies shall be installed in accordance with the manufacturer's recommendations, IEEE standards, and NEC.

C. Devices shown on the drawings and designated herein shall be powered by 120 VAC, 60 Hz, single phase and shall include protective regulation. A constant voltage, uninterruptible power supply shall be provided for the devices to protect from such problems as transient disturbances, voltage dips, voltage surges, noise, brownouts and blackouts, with 60-minute battery backup upon complete power failure. The regulation to all sensitive equipment shall be 3% of the rated value with less than 5% total harmonic distortion.

D. Located within each control panel having a control processor and/or control processor I/O modules installed within, there shall be one uninterruptible power supply. Each uninterruptible power supply shall provide power for all programmable controller processor, I/O, and communication hardware, instrument power supplies, and signal control and indication devices located, or powered from, within the control panel. Each uninterruptible power supply shall be of sufficient size and shall meet the following requirements:

Constant Voltage Regulation/Uninterruptible Power Supply (UPS)	
Function:	Provide constant, regulated clean power, surge protection, galvanic isolation and brownout protection
Surge Protection:	459 Joules surge energy rating
Filtering:	Full time multi-pole noise filtering 0.3% IEEE surge let through, zero clamping response time, meets UL 1449
Input Voltages:	120 volt, 50-60 Hz (auto sensing)
Output Voltages:	120 volt - 60 Hz, sine wave
Output Power:	1000 Watts / 1440 VA
Output Connections:	Eight NEMA 5-15R Battery Back-Up and one NEMA 5-15R surge protection with individual circuit breaker
Management:	USB and RS232 Interface Ports
Battery Type:	Maintenance free, sealed lead acid, leak-proof
Status Indicators:	LED display with load and battery bar graphs; on-line, on battery, replace battery, and overload indication

Audible Indication:	Distinctive audible alarms for on battery and low battery
Approval:	FCC Part 15 Class A, UL 1778
Temperature:	32 to 104 degrees F
Thermal Dissipation:	135 Btuh
Size:	As required with 25% additional capacity and 60 minutes minimum runtime at total device load, 1440 VA minimum
Warranty:	2-year warranty, repair or replace
Manufacturer:	American Power Conversion (APC)
Part No.:	Smart-UPS, SMT 1500

E. The Contractor shall provide a minimum of one spare 120 VAC outlet in the Control Room, powered from the UPS. The location of the outlet in the Control Room shall be approved by the Owner and the Engineer.

2.06 NETWORK DEVICES

A. The monitoring/control system shall be networked for accessibility. Ethernet switches shall be provided and installed for necessary connectivity between the control processors, the operator interface workstations, and other devices shown on the drawings and described herein, over fiber and Category 6 cable in accordance with Section 16121.

1. Fiber-Optic Managed Switches:

a. Source power for the Ethernet managed switch shall be from a constant voltage, battery-backed, uninterruptible power supply.

b. The fiber optic managed switches shall be fully manageable. Interfaces shall include Ethernet 100Base-FX network host and Ethernet 10Base T/100Base-TX network node. The switches shall be securely and remotely manageable through Web interface. Each fiber optic managed switch shall be as follows:

Performance:	Layer 2 switching, 8000 MAC addresses
Network Host Port:	100Base-FX fiber uplink port
Network Node Ports:	Eight 10/100Base-TX autosensing ports with auto MDI/MDX
Switching:	Store and forward 3.6 Gbps switching 2.69 Mbps forwarding
Traffic Control:	IEEE 802.1p traffic prioritization
Communication Mode:	Full/half duplex and negotiation
Security:	Radius session accounting SSHv2 IEEE 802.1x network login
Management	Web interface, command line, TELNET; SNMP compatibility
Immunity:	EN 55024

Power Requirements:	120 VAC/60 Hz
Manufacturer:	3Com
Model:	OfficeConnect Managed Switch 9 FX

2. Wirespeed 10/100/1000 Switch:

   a. Source power for the Ethernet switch shall be from a constant voltage, battery-backed, uninterruptible power supply.

   b. The switch interfaces shall include Ethernet 10/100/1000Base-TX network node. The switch shall be as follows:

Performance:	Layer 2 switching, 8000 MAC addresses, full two-way data transfer
Network Node Ports:	Eight 10/100/1000Base-TX non-blocking, auto-sensing ports with Link Aggregation Control Protocol, support for 16 VLANs
Switching:	Store-and-foreward, 13.6 Gbps
Traffic Control:	IEEE 802.1X Radius authentication an daccounting, Port Sercurity, Storm Control, DoS attack prevention
Communication Mode:	Full/half duplex auto negotiation
Power Requirements:	120 VAC/60 Hz
Warranty:	Limited Lifetime
Manufacturer:	Cisco
Model:	200 Series Small Business

PART 3 EXECUTION

3.01 INSTALLATION

A. All components of the system shall be fully assembled, front accessible, with power supplies, processor, communication modules, I/O modules, and all auxiliary equipment wired to terminal strips within the enclosure.

B. Digital input and output signal sources shall provide an isolated contact rated at 5 amp minimum, 115 VAC to the PCS.

C. Analog input signals to the PCS shall be isolated 4-20 mA DC and where required, current to current transducers or other devices shall be furnished to produce an isolated signal to the programmable controller analog input modules.

D. Circuit breakers shall be provided on the hot side of digital inputs. These circuit breakers shall be coordinated with the main control power fuse or circuit breaker so that no more than eight digital inputs are disabled by the tripping of a single circuit breaker. Digital inputs shall be so arranged that the tripping of a single circuit breaker shall not disable inputs directly controlling more than one motor or other piece of machinery.

E. All programmable controller hardware shall be powered through a battery backed power supply having protective power regulation.

F. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specific in UL Standards 486A and UL 486B.

G. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.02 IDENTIFICATION

A. Identify components in accordance with Section 16030.

B. Individual nameplates shall be labeled to match the single line and schematic Drawings.

3.03 TESTING AND INSPECTION

A. Verify network settings to be appropriate for final system arrangement and conditions. Where discrepancies are found, test organization shall recommend final network settings. Use accepted revised settings to make the final system adjustments.

B. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with single line and/or schematic diagrams.

C. Exercise and perform operational tests of all mechanical and electrical components and other operable devices in accordance with manufacturer's instruction manual.

D. Check connector, terminals, modules, and mountings for tightness to ensure that all components are securely attached.

E. Check tightness of electrical connections by visually looking at wiring and pulling on wires for tightness in terminals. All wires shall be properly restrained.

F. Contractor shall check all I/O points from module to field device for proper operation and signal response verification.

G. Programming of unit(s) shall be based on standards given by Owner or listed within Programming Requirements document.

PART 4 SPECIAL PROVISIONS

4.01 SPARE PARTS

A. The Contractor shall furnish spare parts as shown in the Spare Parts Schedule. The spare parts shall be individually packaged for protection against dirt and moisture. Each package shall be labeled as to its contents, including a description and part number.

B. All spare parts shall become the property of the Owner. The Contractor shall maintain the spare parts inventory level as shown in the Spare Parts Schedule, and replace at no cost to the Owner all spare parts consumed during the start-up procedures and during the one-year warranty period.

4.02 SPARE PARTS SCHEDULE

A. In addition to the requirements of 2.01, the Contractor shall provide a minimum of 10% spare modules for each type of module installed, with a minimum of one of each type. Contractor shall provide at least one spare programmable controller for each type installed.

B. One spare lithium battery shall be provided for each control processor.

C. One spare Ethernet switch shall be provided. This spare switch shall have the same quantity and type of parts as the largest switch provided under this Section.

END OF SECTION

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ATTACHMENT D
DRAWINGS/PLANS

Contract 76 B.1 – Biological Foul Air Mitigation System – Construction - Rebid

Bid Reference #: 91359-003.0

February 2022

LOCATION MAP

KAL-77250(CV)-COVER SHEET
I:/2022/22-0077/s SWILLIS
1/28/2022 2:29 PM

KALAMAZOO, MICHIGAN

KWRP BIOFILTRATION

CONTRACT 76

2022

ADMINISTRATION

JAMES RITSEMA - CITY MANAGER

JAMES J. BAKER, PE - PUBLIC SERVICES DIRECTOR & CITY ENGINEER

JIM CORNELL - WASTEWATER DIVISION MANAGER

RON JANSSEN - TREATMENT OPERATIONS SUPERINTENDENT

CHRIS NELSON - COLLECTIONS AND PLANT MAINTENANCE MANAGER

RYAN STOUGHTON, PE - ASSISTANT CITY ENGINEER - WASTEWATER

MEMBERS OF COMMISSION

DAVID ANDERSON - MAYOR

DON COONEY - VICE MAYOR

STEPHANIE HOFFMAN

ESTEVEN JUAREZ

QIANNA DECKER

JEANNE HESS

CHRIS PRAEDEL

THE CITY OF Kalamazoo

Jones & Henry Engineers, Ltd.

Fluid thinking©.
www.JHeng.com

STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022

YARD PIPING LEGEND

UTILITY LINES:

- AA — AERATION AIR
- AL — ALUM
- C — CABLE (UNDERGROUND)*
- CA — COMPRESSED AIR
- CL — CHLORINE SOLUTION
- CO — COMBINED SEWER
- CW — COLD CITY WATER
- CLG — CHLORINE GAS
- DG — DIGESTER GAS
- DS — DIGESTED SLUDGE
- DW — DILUTION WATER
- EW — EFFLUENT WATER
- E — Electrical (Underground)*
- FC — FERRIC/FERROUS CHLORIDE
- FD — FOUNDATION DRAIN
- FE — FINAL EFFLUENT
- FO — FIBER OPTIC
- FU — FUEL OIL
- G — GAS LINE (OFF SITE)
- GR — GREASE
- IC — IRON CHLORIDE
- HW — HOT CITY WATER
- ML — MIXED LIQUOR
- NG — NATURAL GAS
- P — POLYMER
- PE — PRIMARY EFFLUENT
- PS — PRIMARY SLUDGE
- PW — PLANT WATER
- RAS — RETURN ACTIVATED SLUDGE
- RD — ROOF DRAIN
- RS — RAW SEWAGE
- SA — SANITARY SEWER
- SB — SECONDARY BYPASS
- SC — SCUM
- SE — SECONDARY EFFLUENT
- S — SIGNAL (UNDERGROUND)*
- SPA — SPARE
- ST — STORM SEWER
- SM — STEAM
- SP — DIGESTER SUPERNATANT
- TD — TANK DRAIN
- T — TELEPHONE (UNDERGROUND)*
- TE — THICKENER EFFLUENT
- TS — THICKENED SLUDGE
- WAS — WASTE ACTIVATED SLUDGE
- ST54 — LARGE DIAMETER LINES (ANY TYPE)
- UTILITY LINE TO BE REMOVED
- UTILITY LINE TO BE ABANDONED
- SA5 — NEW UTILITY LINE
- 54" SANITARY SEWER — LARGE DIAMETER NEW UTILITY LINE

ALPHA DESIGNATION REFERS TO UTILITY TYPE, NUMERICAL DESIGNATION REFERS TO PIPE NOMINAL DIAMETER. LINES WITH NO NUMERICAL DESIGNATION ARE OF UNKNOWN SIZE.

* AERIAL LINES, IF SHOWN, ARE DESIGNATED WITH LOWER CASE LETTERS

SYMBOLS:

- (SA) — MANHOLE (ALPHA DESIGNATION REFERS TO UTILITY TYPE, "U" IS "UNKNOWN" TYPE)
- PP — POWER POLE OR TELEPHONE POLE
- LP — LIGHT POLE
- FH, YH — FIRE HYDRANT OR YARD HYDRANT
- VALVE
- CO — CLEAN OUT
- IP — IRON PIN (OR LABELED POST, MARKER ETC.)
- CATCH BASINS
- SIGN
- BOLLARD
- BORING B-2 — SOIL BORING

STANDARD ABBREVIATIONS

ALUM.	ALUMINUM	MAX.	MAXIMUM
AVE.	AVENUE	MH	MANHOLE
BM	BENCH MARK	MJ	MECHANICAL JOINT
BF	BLIND FLANGE	MIN.	MINIMUM
BLDG.	BUILDING	N	NORTH
C/C	CENTER TO CENTER	NTS	NOT TO SCALE
CK'D PL.	CHECKERED PLATE	OC	ON CENTER
CONC.	CONCRETE	OD	OUTSIDE DIAMETER
DIA.	DIAMETER	PE	PLAIN END
DWG.	DRAWING	R	RADIUS
EW	EACH WAY	RR	RAILROAD
EF	EACH FACE	S	SOUTH
ECC.	ECCENTRIC	SCH.	SCHEDULE
EL.	ELEVATION	SH.	SHEET
E	EAST	SS	STAINLESS STEEL
EX.	EXISTING	ST.	STREET
F	FLANGE	STA.	STATION
' OR FT.	FEET OR FOOT	T&B	TOP AND BOTTOM
GAL.	GALLON	TYP.	TYPICAL
GR.	GRADE	VERT.	VERTICAL
HOR.	HORIZONTAL	W	WEST
" OR IN.	INCH	W/	WITH
ID	INSIDE DIAMETER	T/B	TOP OF
INV. EL.	INVERT ELEVATION	TOC	TOP OF CONCRETE
		B/	BOTTOM OF

PIPING ABBREVIATIONS

MATERIAL

ABS	ABS ACRYLONITRILE-BUTADIENE-STYRENE
ABSC	ABS COMPOSITE SEWER PIPE (TRUSS PIPE)
BSP	BLACK STEEL PIPE
CIP	CAST IRON PIPE
CISP	CAST IRON SOIL PIPE
CMP	CORRUGATED METAL PIPE
CPP	CONCRETE PRESSURE PIPE
CPT	CORRUGATED POLYETHYLENE TUBING
CPVC	CHLORINATED POLYVINYL CHLORIDE PIPE
Cu	COPPER TUBING OR PIPING
DIP	DUCTILE IRON PIPE
FRP	FIBERGLASS REINFORCED PIPE
GLDIP	GLASS-LINED DUCTILE IRON PIPE
GSP	GALVANIZED STEEL PIPE
HDPE	HIGH DENSITY POLYETHYLENE
PCP	PLAIN CONCRETE PIPE
PE	POLYETHYLENE
PP	POLYPROPYLENE
PPVC	PERFORATED POLYVINYL CHLORIDE PIPE
PVC	POLYVINYL CHLORIDE PIPE
PVCP	PERFORATED VITRIFIED CLAY PIPE
PVDF	POLYVINYLIDENE FLUORIDE (KYNAR)
RCP	REINFORCED CONCRETE PIPE
SP	STEEL PIPE
SSP	STAINLESS STEEL PIPE
SWS	SPIRAL WELDED STEEL
UPVC	UNPLASTICIZED POLYVINYL CHLORIDE PIPE
VCP	VITRIFIED CLAY PIPE

SERVICE

PS	PRIMARY SLUDGE
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE
DS	DIGESTED SLUDGE
SC	SCUM
SP	SUPERNATANT
DG	DIGESTER GAS
NG	NATURAL GAS
CW	CITY WATER
HW	HOT CITY WATER
EW	EFFLUENT WATER
PW	PROTECTED WATER
CA	COMPRESSED AIR
TD	TANK DRAIN
SS	SANITARY SEWER
ST	STORM SEWER

VALVE SYMBOL LEGEND

- GATE, KNIFE GATE, BUTTERFLY OR GLOBE VALVES
- PLUG VALVE
- BALL VALVE
- PINCH VALVE
- CHECK VALVE

STRUCTURAL LEGEND

- EXISTING STRUCTURE
- EXISTING STRUCTURE TO BE REMOVED
- NEW CONCRETE STRUCTURE
- NEW BLOCK WALL
- NEW BRICK WALL

PIPING AND EQUIPMENT LEGEND

- EXISTING PIPING
- EXISTING PIPING OR EQUIPMENT TO BE REMOVED (IF YARD PIPING, ABANDON AND REMOVE AS REQUIRED)
- EXISTING PIPING OR EQUIPMENT TO BE RELOCATED
- NEW PIPING

8/12 = NUMBER OF SECTION / SHEET NUMBER ON WHICH SECTION IS SHOWN

SECTION 3/4 = NUMBER OF SECTION / SHEET NUMBER ON WHICH SECTION IS CUT

DELINEATION OF SECTIONS

(SECTIONS LETTERED ARE SHOWN ON SAME SHEET)

NOTE:
SECTION NUMBERS REFER TO DRAWINGS WITH THE SAME 2 LETTER PREFIX.

A = ELEVATION VIEW

5/7 = NUMBER OF DETAIL IN SECTION / SHEET NUMBER ON WHICH DETAIL IS SHOWN

6/7 = NUMBER OF DETAIL IN PLAN / SHEET NUMBER ON WHICH DETAIL IS SHOWN

DETAIL 5/9 = NUMBER OF DETAIL / SHEET NUMBER ON WHICH DETAIL IS TAKEN

DELINEATION OF BLOW - UP DETAILS

(DETAILS LETTERED ARE SHOWN ON SAME SHEET)

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NOTE:
EQUIPMENT PROCURED BY THE CITY FOR INSTALLATION BY THE CONTRACTOR IN THIS PROJECT INCLUDES ALL LABOR, MATERIAL, AND EQUIPMENT NECESSARY TO RECEIVE, UNLOAD, PROTECT AND STORE, INSTALL/ERECT, CONNECT AND PROVIDE POWER TO/FOR:

1. PRE-ENGINEERED METAL BUILDING PACKAGE - INCLUDES STRUCTURAL MEMBERS/FRAMING, INSULATED METAL WALL PANELS, INSULATED METAL ROOF PANELS, AND APPURTENANCES.
2. BIOFILTER CONTROL PANEL (X1)
3. MEDIA SUPPORT GRATING FOR BIOFILTERS (X3)
4. UPPER SURFACE SPRAY IRRIGATION SYSTEM FOR BIOFILTERS (X3)
5. LOWER IN-BED IRRIGATION SYSTEM FOR BIOFILTERS (X3)
6. BIOFILTER MEDIA (X3 LOTS OF TWO UNIQUE MEDIA TYPES)
7. BIOFILTER INTERNAL BAFFLES (X3 LOTS)
8. 36-INCH X 36-INCH SIDE ACCESS HATCHES FOR BIOFILTER(X3)
9. HUMIDIFICATION CHAMBER SPRAYERS AND PENETRATIONS IN BIOFILTERS (X3)
10. HUMIDIFICATION CHAMBER AIR DEFLECTORS (X3)
11. BIOFILTER BED ALUMINUM COVERS (X3)
12. CARBON SCRUBBERS WITH INTEGRAL MIST/GREASE ELIMINATORS (X3)
13. WATER IRRIGATION CONTROL PANELS (X3)
14. NUTRIENT METERING PUMPS (X3)
15. NUTRIENT TANK (X1)
16. NUTRIENTS (LOT)
17. HUMIDIFICATION RECIRCULATING SUMP PUMPS (X2)
18. PRESSURE/FLOW INSTRUMENTATION (LOT)
19. INTAKE AIR MIST/GREASE ELIMINATOR (X1)
20. CENTRIFUGAL FAN/BLOWERS W/ 50 HP MOTORS (X3)
21. DUCTWORK TRANSITION PIECES INTO/OUT OF PROVIDED FANS/BLOWERS
22. CENTRIFUGAL FAN/BLOWER VFD PANELS, INCLUDES VFDS (X3)

Note:

1. **ALL NOTES ON THE DRAWINGS BEAR THE SAME IMPORTANCE. SOME NOTES AND DIMENSIONS ARE BOLD TO AID IN READING THE DRAWING IN AREAS OF HIGH GRAPHIC DENSITY.**
2. **ACCURACY OF EXISTING ELEVATIONS AND DIMENSIONS IS NOT GUARANTEED. FIELD VERIFY BEFORE CONSTRUCTION.**

THE CITY OF Kalamazoo

LEGEND AND INDEX

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
1	REVISIONS AFTER ISSUED FOR BID	
2		
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G-1

1 OF 44

K:\AL-7725\00\LEG-LEGEND AND INDEX
2/7/2022 2:49 PM
SMILLIS
2/8/2022 2:49 PM

KALAMAZOO RIVER

N

PROPOSED WORK AREA

PUMP STATION AND OUTFALL WEIR STRUCTURE

TERTIARY FILTERS AND CHLORINE CONTACT TANK

HYPOCHLORITE BUILDING

FILTER PIPE GALLERY

DECHLORINATION BUILDING

TERTIARY PUMP STATION

INDUSTRIAL PUMP STATION

INDUSTRIAL DIVERSION CHAMBER NO. 1

CHAMBER E-8

CHAMBER E-7

CHAMBER E-6

CHAMBER E-5

FINAL SETTLING TANK NO. 8

FINAL SETTLING TANK NO. 7

FINAL SETTLING TANK NO. 6

FINAL SETTLING TANK NO. 5

FINAL SETTLING TANK NO. 4

FINAL SETTLING TANK NO. 3

FUTURE TERTIARY BUILDING

PRIMARY SLUDGE THICKENER

24" CAP

PRIMARY SETTLING TANK

24" FOUL AIR (ABANDONED)

PRIMARY SLUDGE THICKENER

24" CAP

PRIMARY SETTLING TANK

PRIMARY SLUDGE THICKENER

30" FOUL AIR (ABANDONED)

PILOT PLANT

CHLORINE STORAGE AREA

16" CAP

STAGING AREA 1

ADMINISTRATION BUILDING

24" FOUL AIR (ABANDONED)

SECONDARY SLUDGE PUMP STATION NO. 2

SECONDARY SLUDGE PUMP STATION NO. 3

SECONDARY SLUDGE PUMP STATION NO. 1

AERATION TANK NO. 9

AERATION TANK NO. 8

AERATION TANK NO. 7

AERATION TANK NO. 6

BLOWER BUILDING

AERATION TANK NO. 5

AERATION TANK NO. 4

AERATION TANK NO. 3

AERATION TANK NO. 2

AERATION TANK NO. 1

PLANT WATER BUILDING

36" FOUL AIR (ABANDONED)

30" CAP

12" FOUL AIR

ELECTRICAL MAINTENANCE BUILDING

RAW WASTEWATER PUMP STATION

BAR SCREEN

30" FOUL AIR (ABANDONED)

SCUM STATION #1

SCUM STATION #2

SCUM STATION #3

30" FOUL AIR (ABANDONED)

DEWATERING FACILITY

PRIMARY THICKENER 2

SECONDARY THICKENER 2

SLUDGE CONTROL BLDG.

MH 11-6

EAST BANK SWITCHGEAR

GROUND SLUDGE STORAGE TANKS

PRIMARY THICKENER 1

SECONDARY THICKENER 1

SERVICE BUILDING

PRIMARY EFFLUENT

24" FOUL AIR

DSE BLDG.

MAINTENANCE BUILDING EAST

PRIMARY SETTLING TANKS

24" FOUL AIR (ABANDONED)

CARBON REGENERATION BUILDING

SOLIDS HANDLING

STORAGE FACILITY

STORAGE BUILDING

FINE SCREEN BLDG.

GRIT TANKS

24" CAP

CARBON MIXING TANK

10"ø Foul Air

WOODS

KAL-7725001G02-EXISTING KWRP PLAN
1/28/2022 2:30 PM - SWILLIS

THE CITY OF Kalamazoo

EXISTING KWRP PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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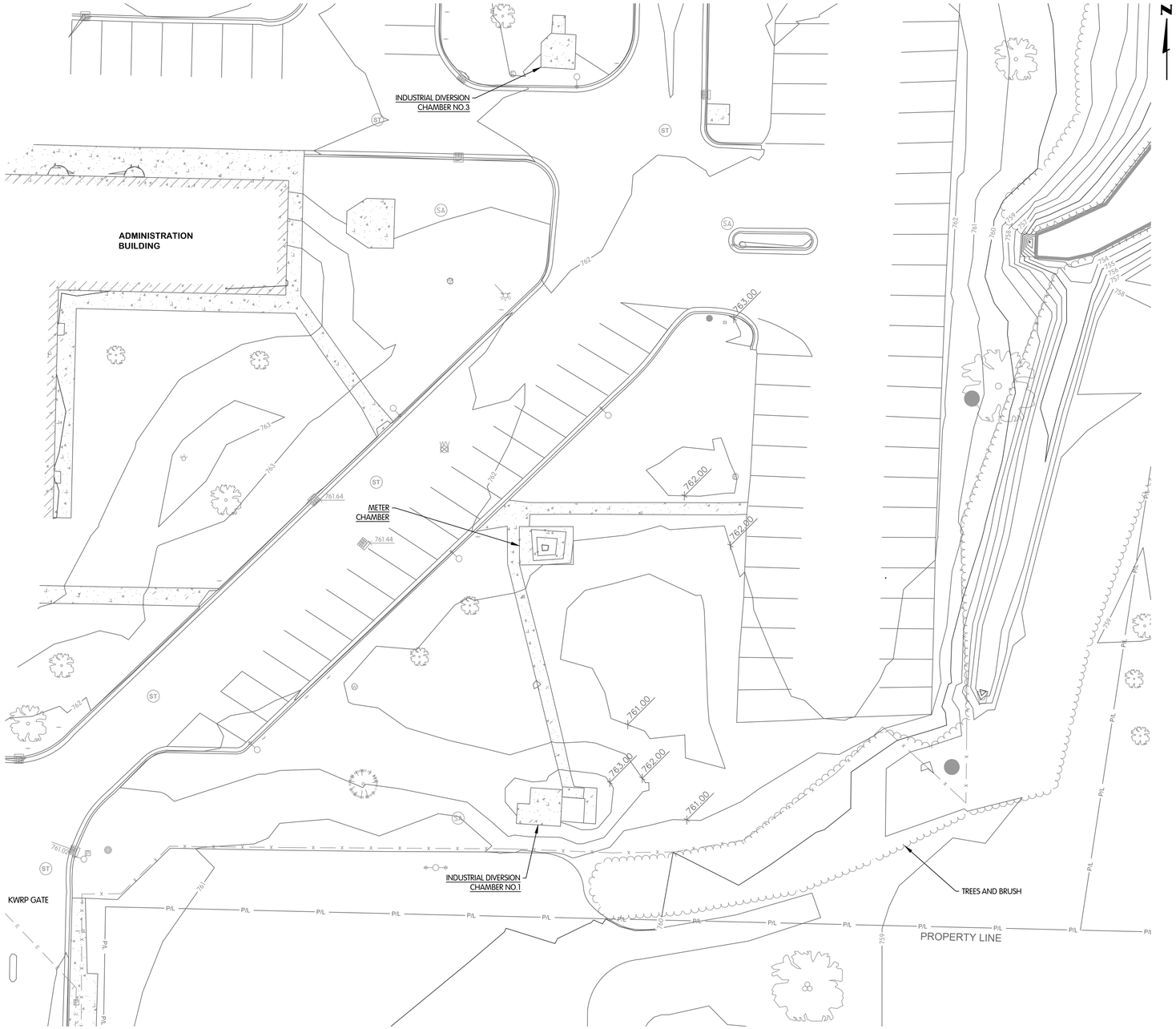
G-2

2 OF 44



EXISTING SITE PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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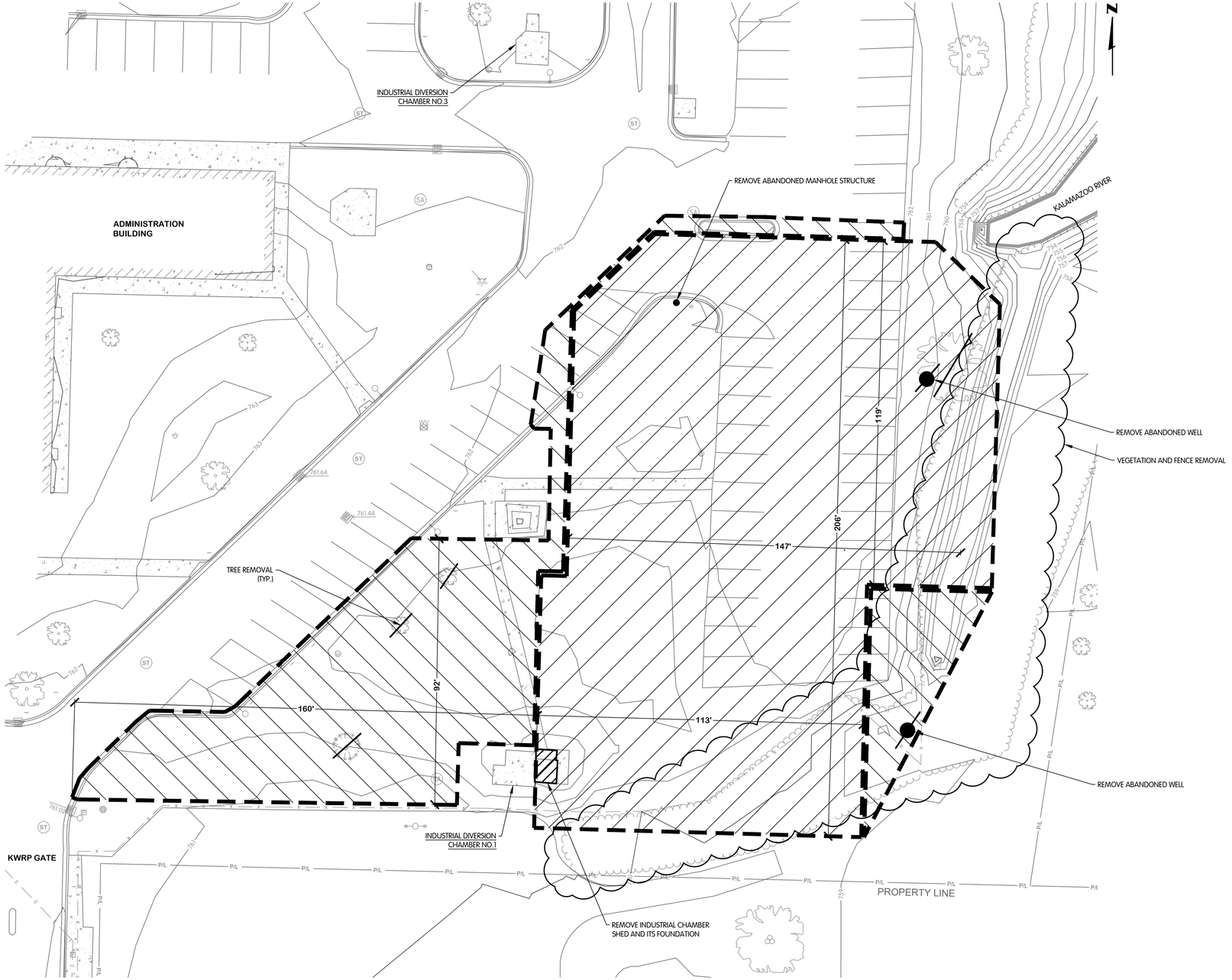
G-3

3 OF 44

KAL-7725001G05-EXISTING SITE PLAN
1/31/2022 5:04:4 SWILLIS
1/28/2022 2:30 PM



LEGEND

REMOVE / EXCAVATE ALL MATERIAL TO ELEVATION OF 749.9, AREA WITHIN BOUNDARY = 26,723 SQFT (SEE SHEET R-2 FOR CROSS SECTIONS)

REMOVE ALL MATERIAL AT SURFACE LEVEL TO BUILD PER SHEET C-1, AREA WITHIN BOUNDARY = 12,105 SQFT

THE CITY OF Kalamazoo

SITE REMOVAL PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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SHEET NO.

R-1

4 OF 44

KAL-7725001R01-SITE REMOVAL PLAN
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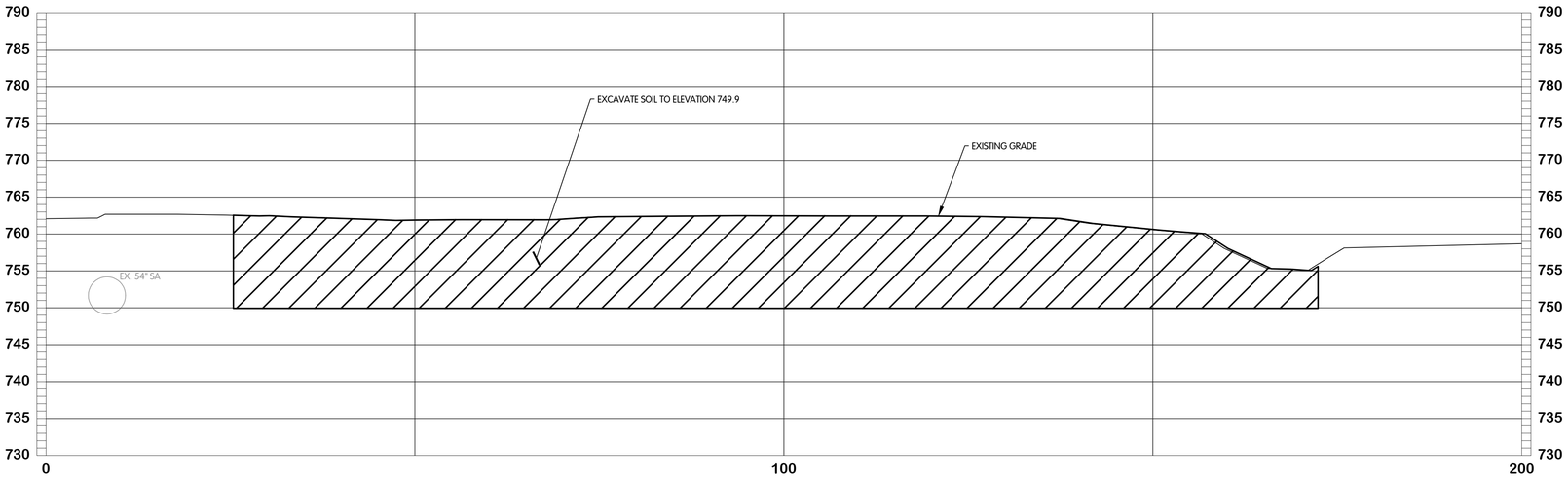

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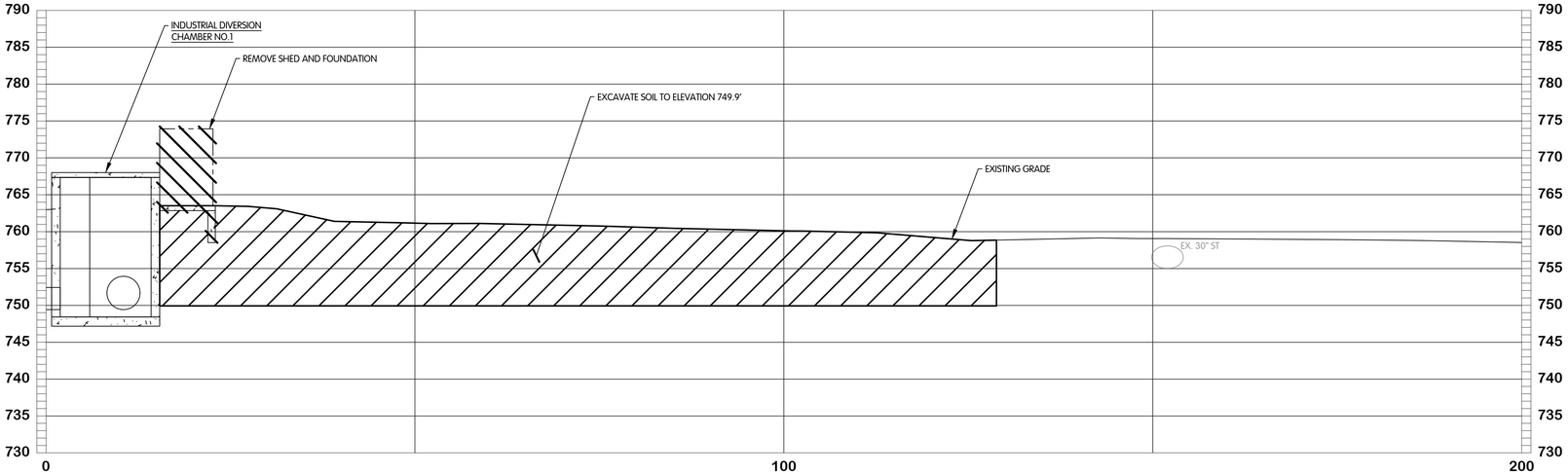
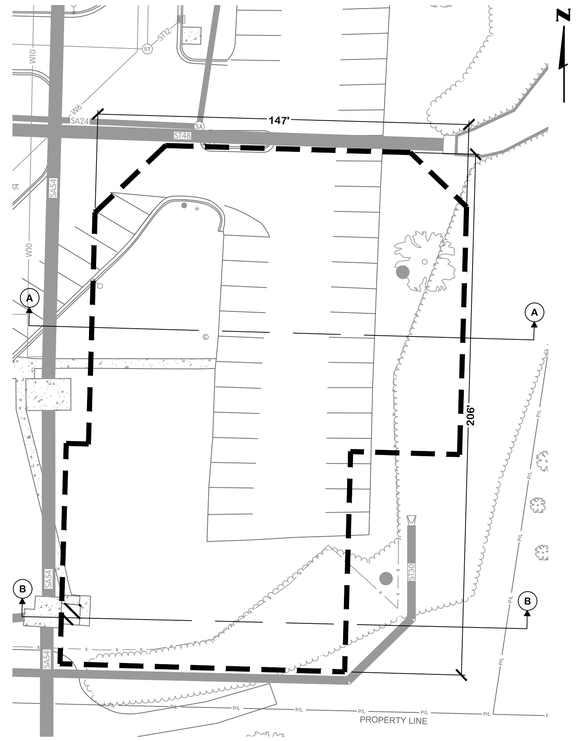


SECTION B



PLAN VIEW

1" = 30'

NOTE: ADDITIONAL EXCAVATIONS MAY BE REQUIRED TO REMOVE INADEQUATE SOILS. CONTRACTOR SHALL WORK WITH GEOTECHNICAL ENGINEER AT TIME OF EXCAVATION TO ENSURE BEARING CAPACITY OF IN-SITU SOILS AT BOTTOM OF EXCAVATION IS ADEQUATE TO RECEIVE FILL MATERIALS. SEE SHEET C-7 FOR REFERENCE SOIL BORINGS AND LOCATIONS

THE CITY OF Kalamazoo

SITE REMOVAL PLAN SECTIONS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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JOB NO.	017-7725.001
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SHEET NO.
R-2
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K:\KAL-7725001R02-SITE REMOVAL PLAN SECTIONS
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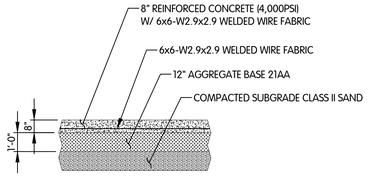


NOTE: GRADE OF CONCRETE SHALL SLOPE AWAY FROM STRUCTURES AND EQUIPMENT AND TOWARDS ENDGE OF PAVEMENT OR DRAINAGE STRUCTURE AT A 1/8" PER FT SLOPE.

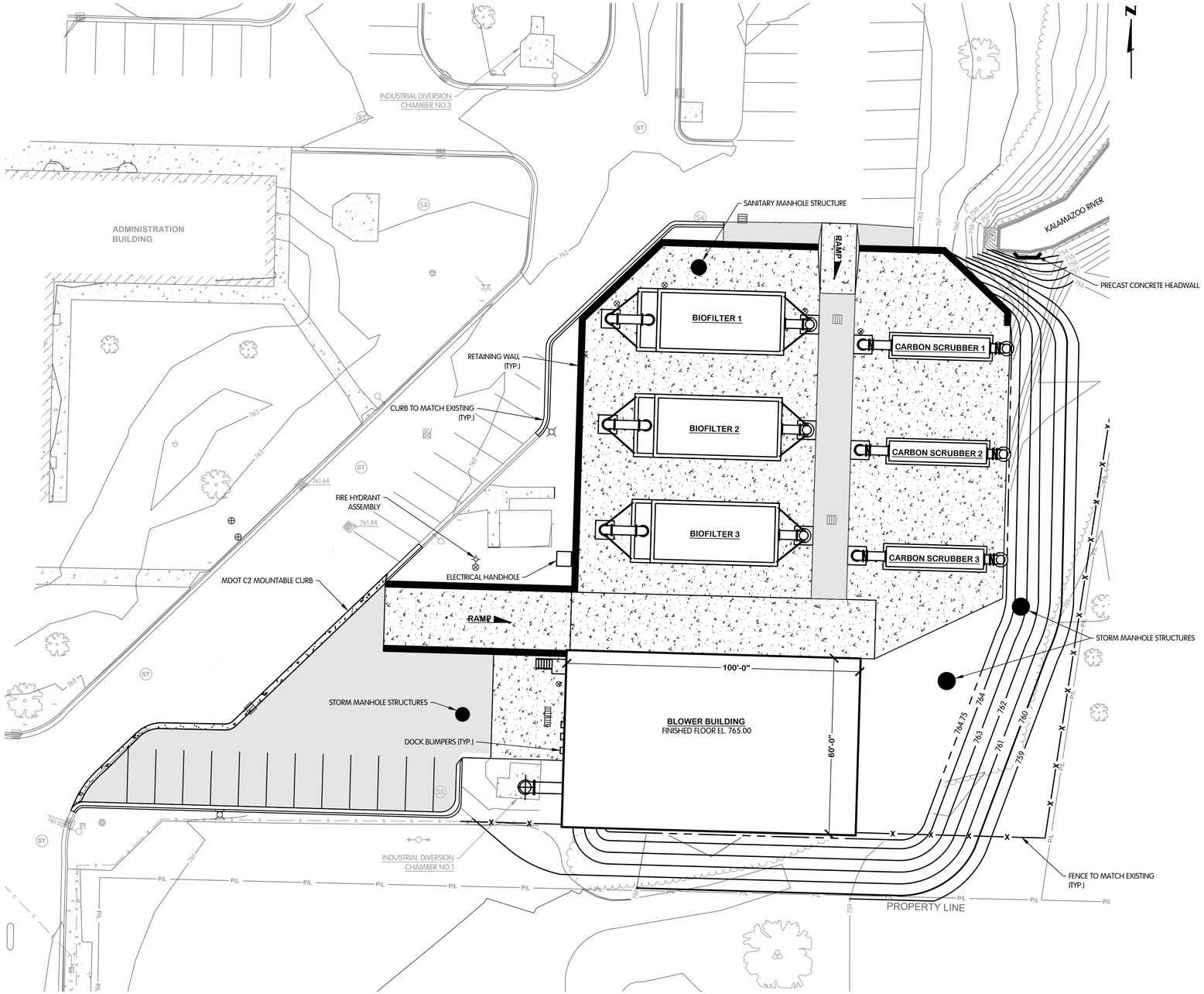
TYP. CONCRETE PAVEMENT SECTION

NTS

LEGEND

CONCRETE PAVEMENT (15,315 SQFT)

ASPHALT PAVEMENT (7,082 SQFT)



KAL-7725001C01-SITE PLAN
MATTHEW.SWILLIS
12/8/2022 2:30 PM - SWILLIS

THE CITY OF Kalamazoo

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

SITE PLAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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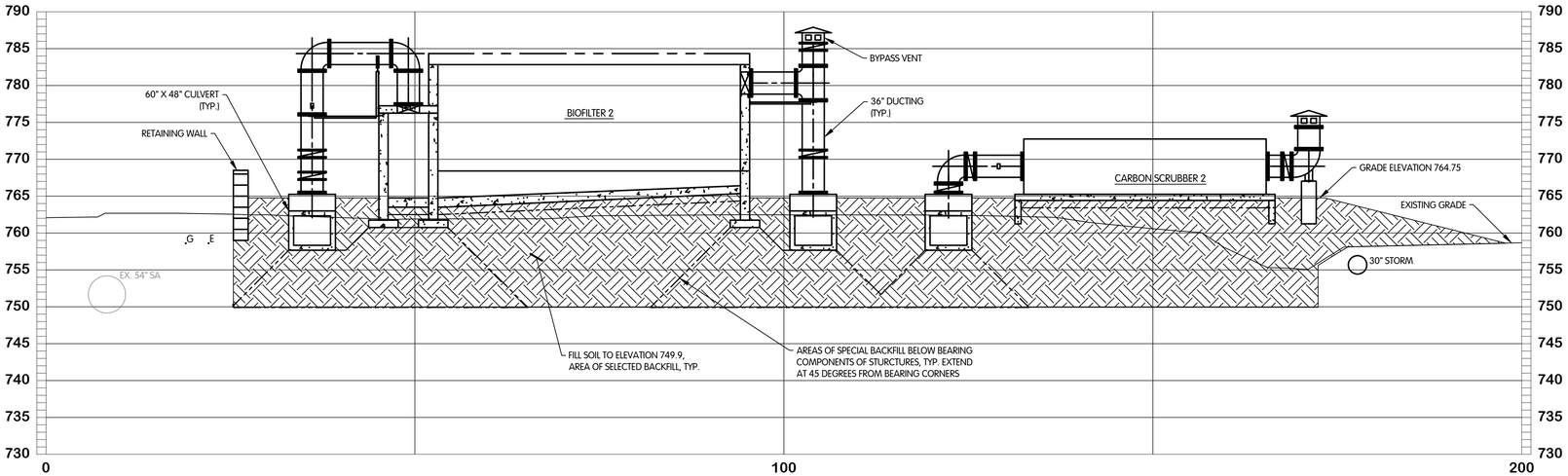

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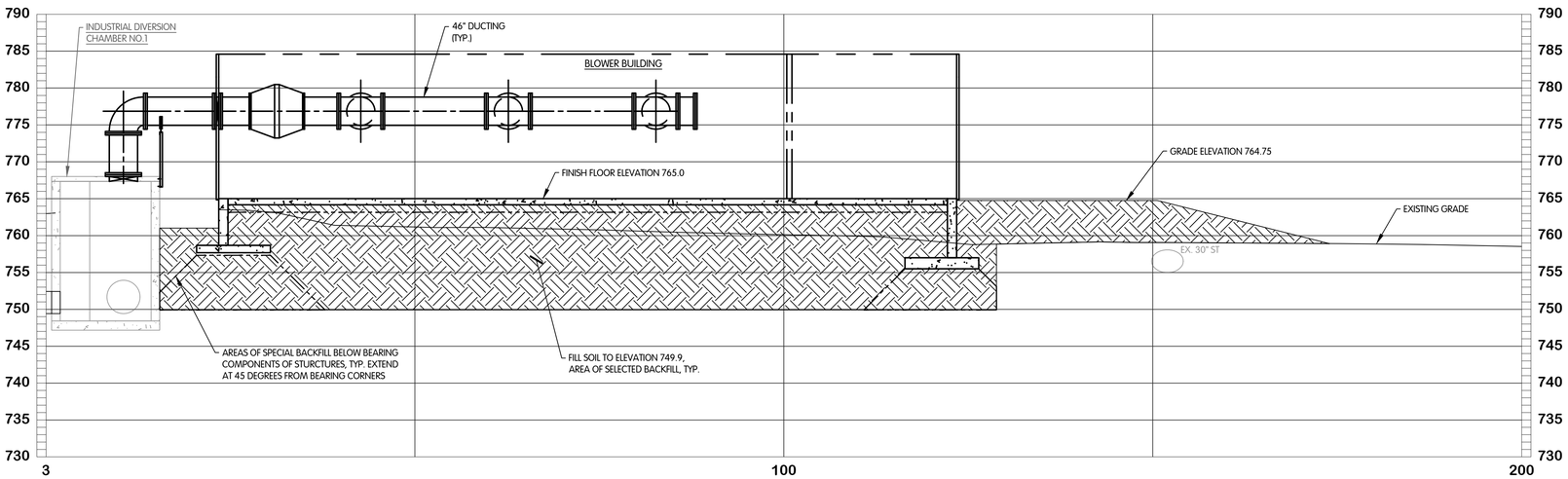

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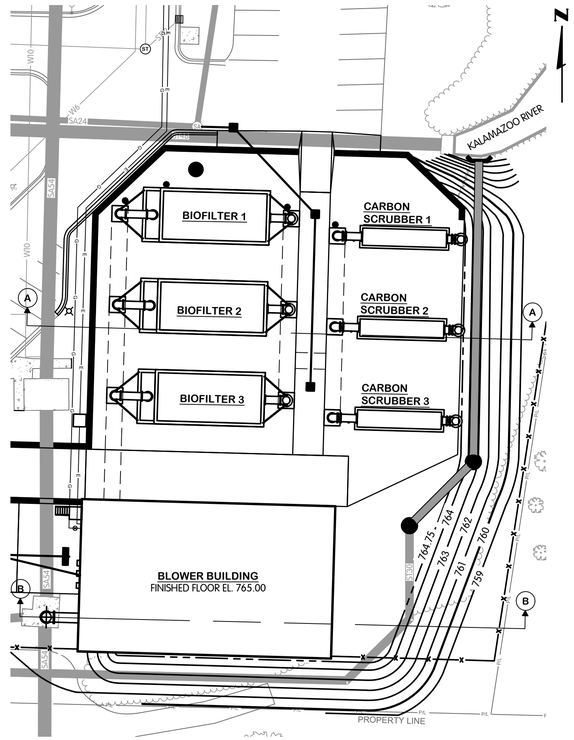

PLAN VIEW

1" = 30'

THE CITY OF Kalamazoo

SITE PLAN SECTIONS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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KAL-77250(604)--SITE PLAN SECTIONS
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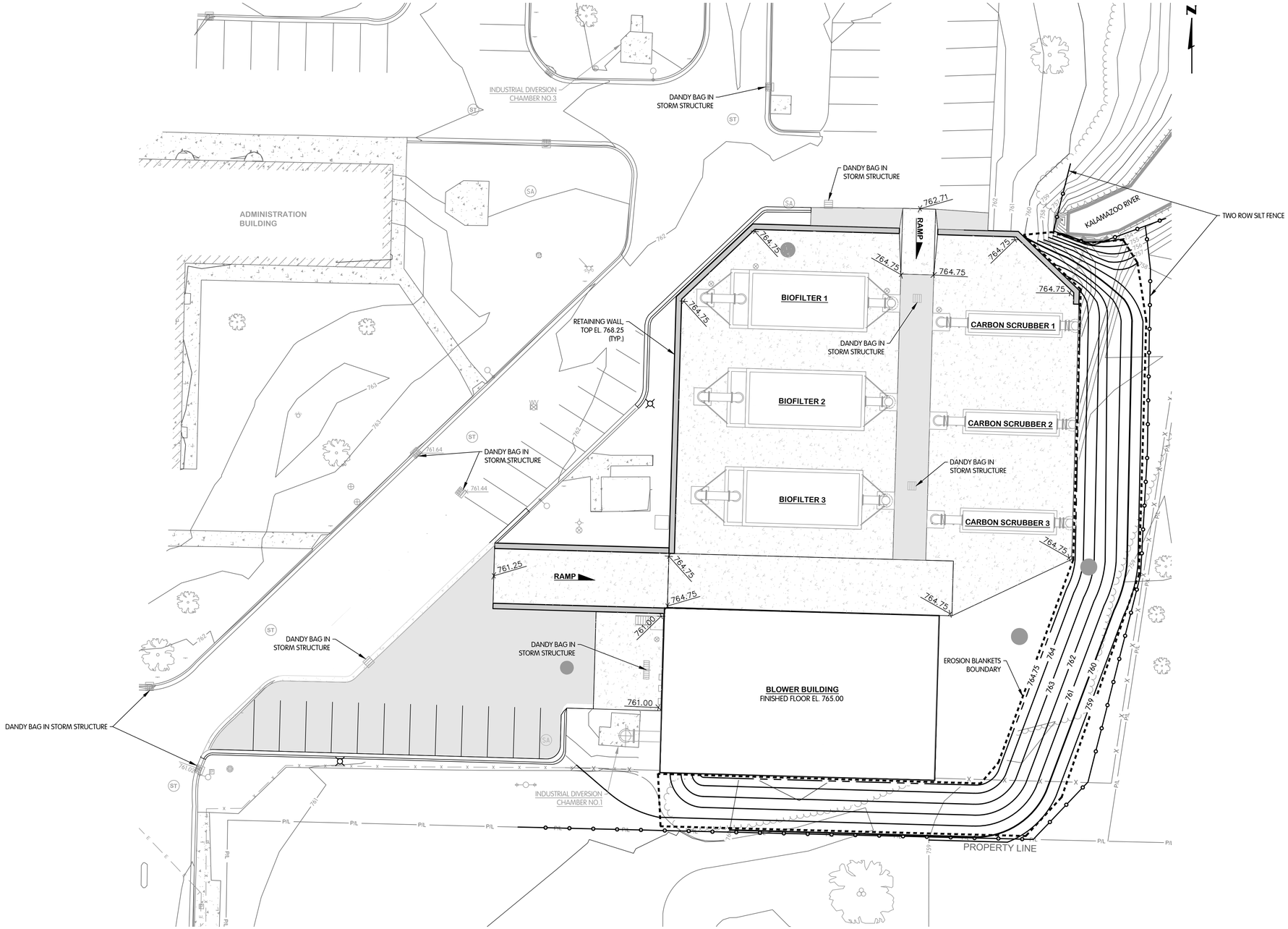
1/28/2022 2:10 PM



KAL-7725001\03-SITE GRADING & EROSION CONTROL PLAN
1/27/2022 12:44 PM S SWILLIS
1/28/2022 2:10 PM

THE CITY OF Kalamazoo

SITE GRADING & EROSION CONTROL PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

ISSUE NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY

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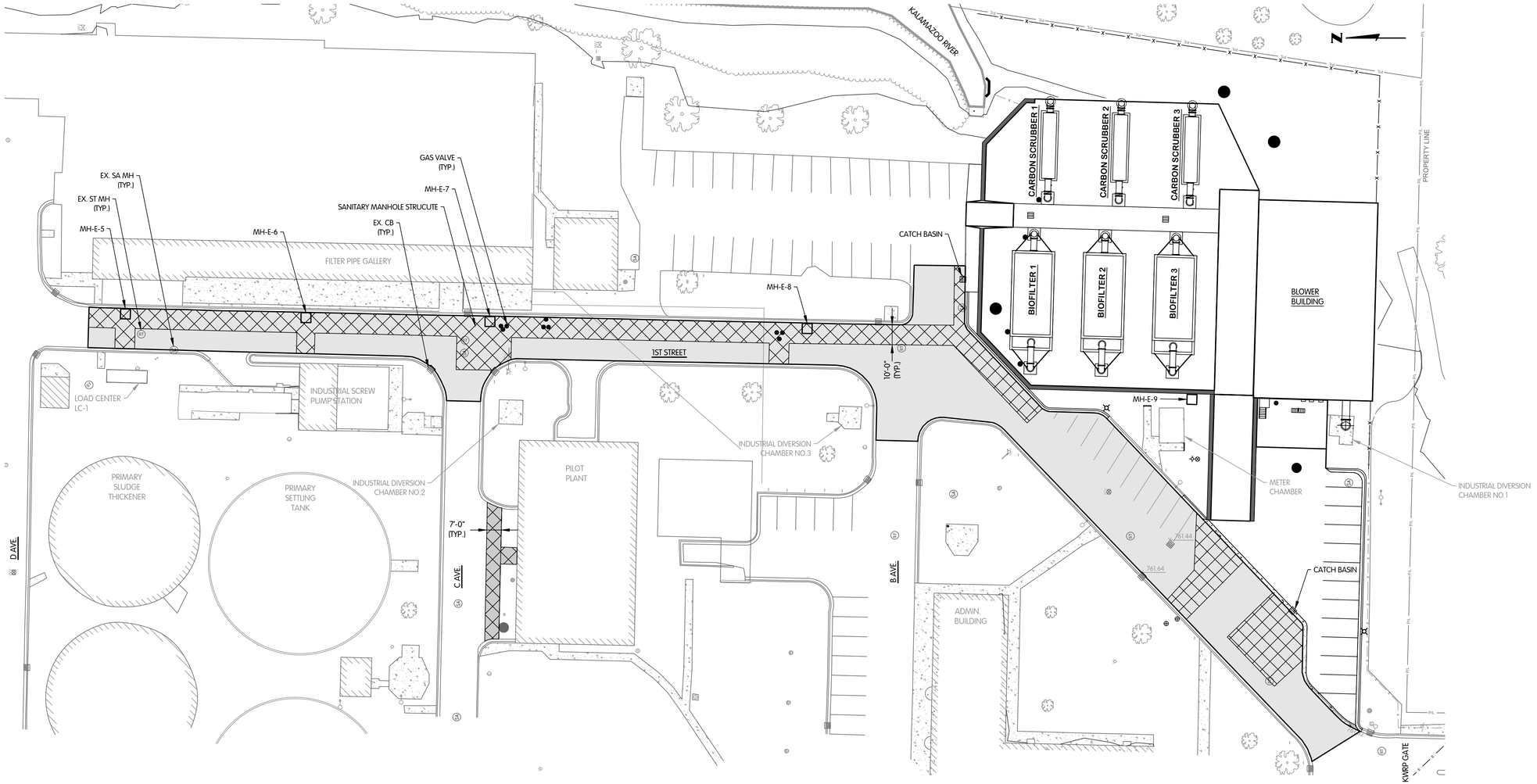

LEGEND

MILL AND OVERLAY PAVEMENT (22,081 SQFT)

TRENCH REPAIR

NOTE: REMOVE AND REPLACE CURB WHERE NECESSARY.

SURFACE RESTORATION PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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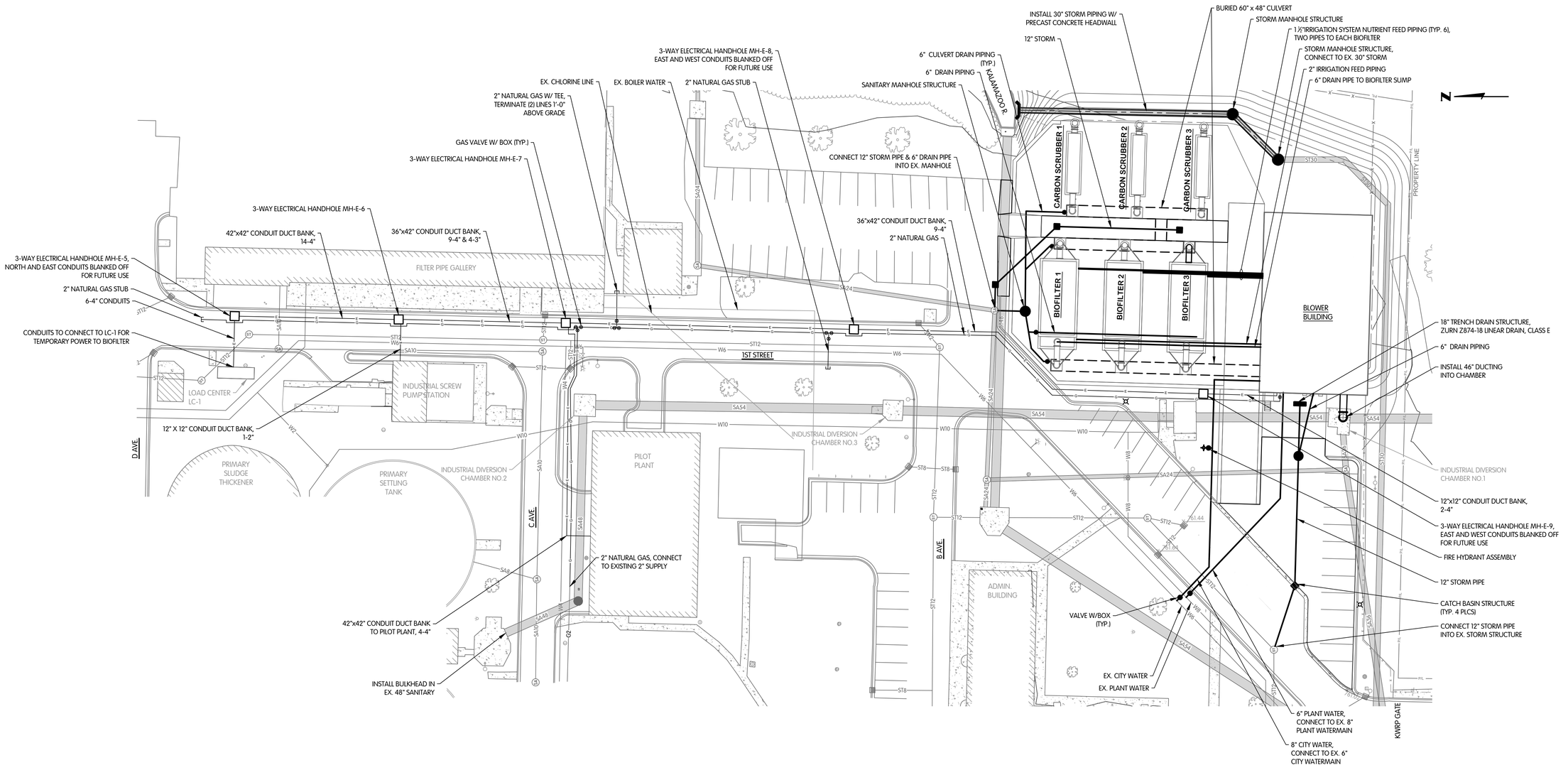
K:\KAL-7725001SR01-SURFACE RESTORATION PLAN
(7725001-SR01-SURFACE RESTORATION PLAN.DWG)
1/28/2022 2:30 PM - SWILLIS



NOTES:

1. CONTRACTOR SHALL SLEEVE AROUND ANY CONDUIT AND PIPING FOUND DURING EXCAVATION FOR INSTALLATION OF DUCTBANK.
2. EXACT POSITION OF ELECTRICAL HANDHOLES WILL BE DETERMINED ONCE SURROUNDING UTILITIES HAVE BEEN LOCATED.
3. PLANT WATER PIPING ASSUMED TO BE 5 FEET BELOW GRADE.
4. CITY TO PROVIDE ELECTRICAL HANDHOLE STRUCTURES.
5. ALL UNDERGROUND CONDUIT TO BE PVC SCHEDULE 40 MINIMUM.
6. ALL UNDERGROUND CONDUIT ELBOWS TO BE RIGID GALVANIZED STEEL.
7. ALL CULVERT TO BE HS20 LOAD RATED.
8. CULVERT JOINTS SHALL BE GAS TIGHT.

THE CITY OF Kalamazoo

YARD PIPING PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
1			
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DATE: FEBRUARY 2022

SHEET NO.

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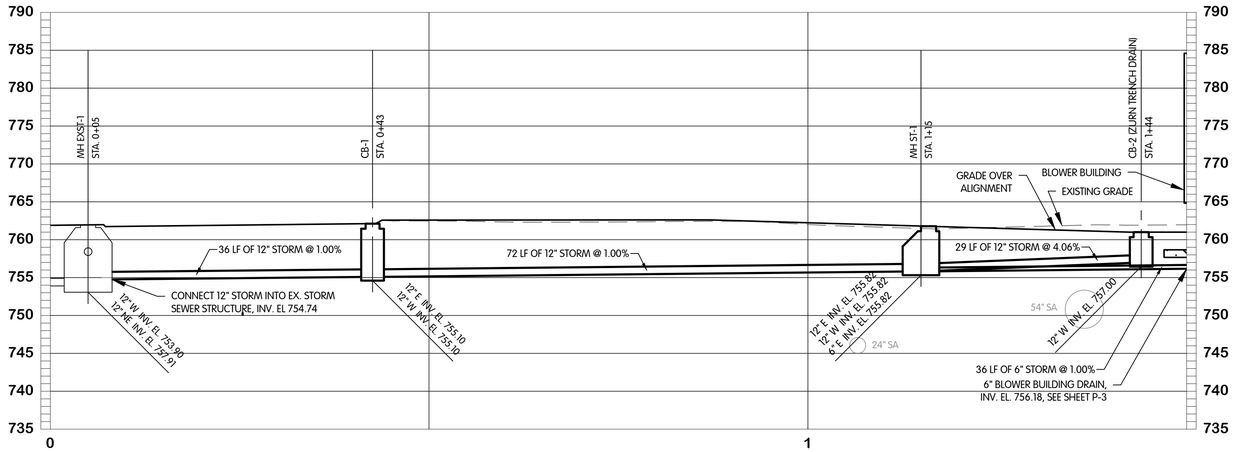
KAL-772500\YPDI-YARD PIPING PLAN
1/27/2022 2:30 PM
J. SWILLIS



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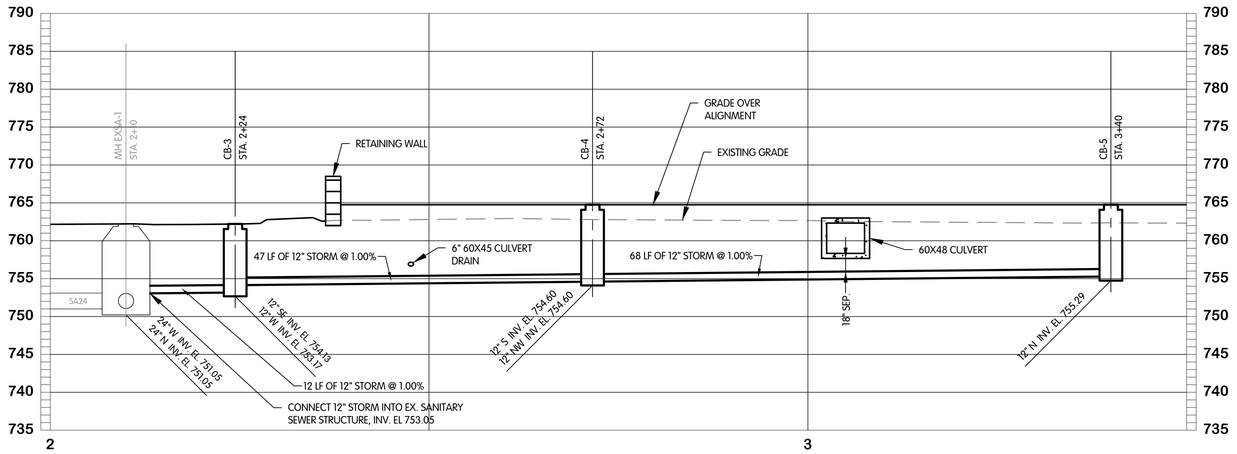
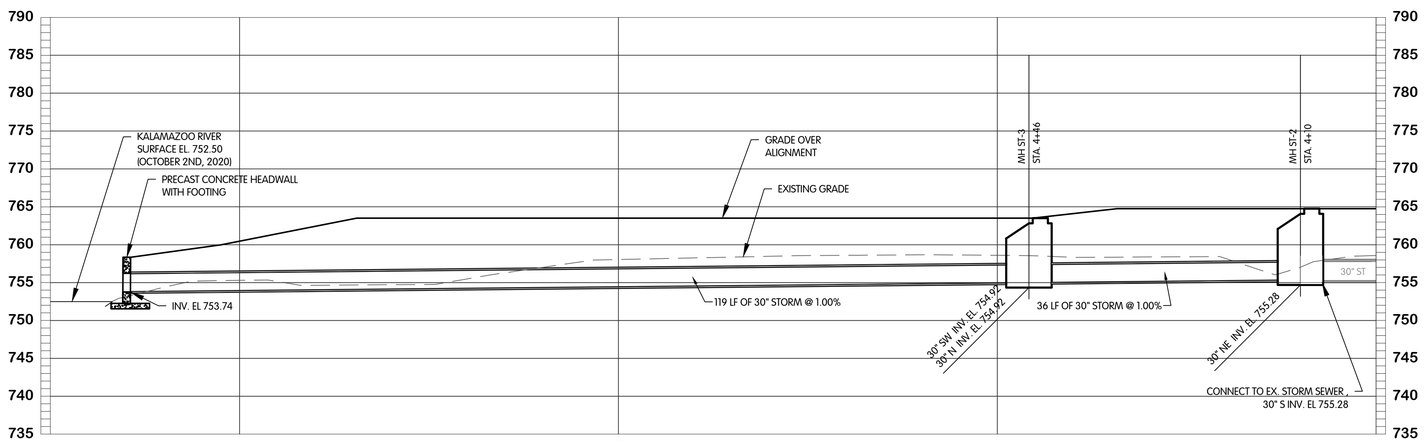
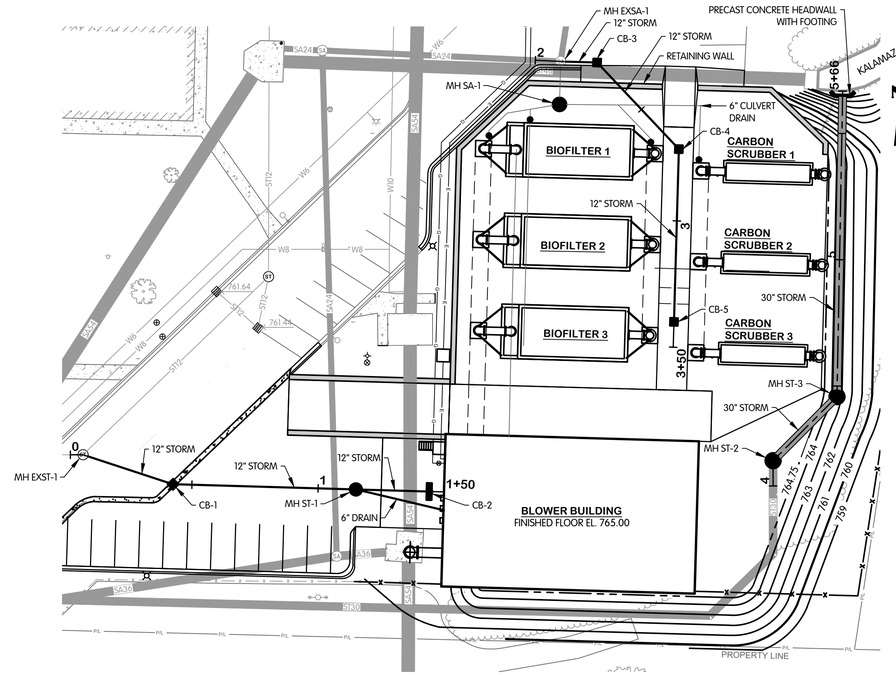


STA. 2+00 TO 3+50



STA. 4+00 TO 5+66



PLAN VIEW

1" = 30'

KAL-77250(0)07-STORM PLAN VIEW AND SECTIONS
LAST PLOTTED: 12/27/2021 12:37 PM - S WILLIS
I:\28\2022 2.50 PM

THE CITY OF Kalamazoo

SITE PLAN SECTIONS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

Jones & Henry Engineers, Ltd.

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JOB NO. 017-7725.001

SCALE 1" =10'-0"

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
ADK	CJAF	AJD

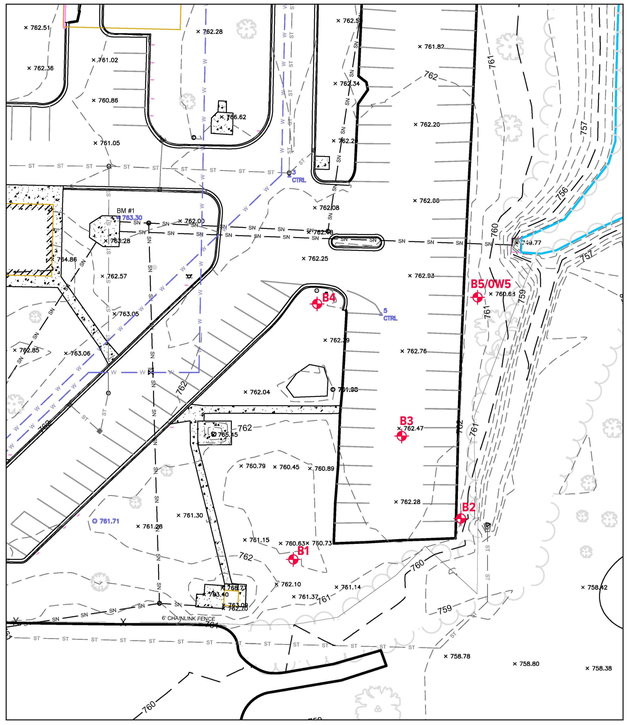
STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

C-6

11 OF 44



LOCATION MAP
NOT TO SCALE

0' 40' 80'
GRAPHIC SCALE: 1" = 40'

LEGEND

- APPROXIMATE BORING LOCATION
- WATER MAIN
- STORM SEWER
- SANITARY SEWER
- O/H POWER
- U.G. POWER

GENERAL NOTES:

1. Utilities shown are approximate locations derived from actual measurements. They should not be interpreted to be exact locations nor should it be assumed that they are the only utilities in this area.
2. Benchmark #1: Plastic tag stamped "763.76" near the NE corner of overflow chamber East of the Administration Building. ELEVATION:763.30 (NAVD88).
3. Basis of Coordinates: Michigan State Plane South, International feet.
4. Control Point Information:

NO.	NORTHING	EASTING	ELEV	
1	296855.290	12797095.924	760.27	MAG NAIL
2	296626.441	12797089.940	761.54	MAG NAIL
3	296403.981	12797084.294	761.92	MAG NAIL
4	296177.009	12796873.824	761.58	MAG NAIL
5	296331.126	1279732.506	762.99	MAG NAIL

NOTE:
BASE DRAWING INFORMATION TAKEN FROM A CAD FILE 2672002 - KALAMAZOO WWTP.dwg, TITLED "TOPOGRAPHIC SURVEY FOR THE CITY OF KALAMAZOO WATER RECLAMATION FACILITY" DATED DECEMBER 4, 2020 AND PREPARED BY SUMMIT SURVEYING, INC.

SME
WWW.SME-USA.COM

Project
KWRP BIOFILTRATION ODOR CONTROL

Project Location
CITY OF KALAMAZOO, MICHIGAN

Sheet Name
BORING LOCATION DIAGRAM

No.	Revision Date

Date 7/30/2021
CADD JAB
Designer AJR
Scale AS NOTED
Project 085267.00
Figure No. 1

DRAWING NOTE: SCALE DISPECTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA
NO REPRODUCTION SHALL BE MADE WITHOUT THE PRIOR CONSENT OF SME
©2021

BORING B1

PAGE 1 OF 1
BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 761± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
761.5	0.0	10 inches of TOPSOIL	760.2
	1.3	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense (SP-SM)	
	7.0	FILL- Fine to Medium SILTY SAND- Brown and Black- Moist to Wet- Medium Dense (SM)	754.5
	8.5	BURIED TOPSOIL- SANDY SILTY CLAY- Occasional Root Fragments- Black (CL/ML)	753.0
	10.0	Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Medium Dense (SP)	751.5
	22.0	Fine to Coarse SAND- Gray- Wet- Medium Dense (SP)	739.0
	30.0	END OF BORING AT 30.0 FEET.	731.0

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 3 4 4 8 / 4 5 6 8 / 3 4 4 5 / 3 4 5 6 / 3 4 5 6 / 4 6 8 11 / 5 7 8 10 / 6 9 15 / 7 10 12
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: Odors noted and staining observed at Sample SB3.

REMARKS: A loss-on-ignition (LOI) test performed on the buried topsoil portion of Sample SB4 indicates an organic content of about 8.8 percent. The buried topsoil portion of Sample SB4 was too disturbed to perform a shear strength test.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	7.0	754.0
▼ AT END OF BORING:	7.3	753.7
CAVE-IN OF BOREHOLE AT:	9.0	752.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

BORING B2

PAGE 1 OF 1
BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/13/20 **COMPLETED:** 10/13/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 761± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
761.5	0.0	FILL- Fine to Coarse SILTY SAND with Gravel- Occasional Asphalt Pieces- Dark Brown- Moist- Medium Dense (SM)	758.0
	3.5	FILL- Fine to Medium SAND with Silt- Frequent Clayey Sand Layers- Brown- Moist- Medium Dense (SP-SM)	755.0
	6.0	BURIED TOPSOIL- Fine SILTY to CLAYEY SAND- Black- Moist- Loose (SM/SC)	753.0
	10.0	Fine SILTY SAND- Frequent Sandy Organic Silt Layers and Seams- Brown- Moist to Wet- Very Loose (SM)	749.0
	13.0	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Medium Dense (SP)	746.0
	18.0	Fine to Medium SAND- Brown and Gray- Wet- Medium Dense (SP)	743.0
	21.5	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Medium Dense (SP)	739.5
	30.0	END OF BORING AT 30.0 FEET.	731.0

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 6 8 8 8 / 8 8 6 6 / 5 4 4 5 / 1 1 2 3 / 6 7 10 12 / 7 8 10 12 / 9 10 11 12 / 11 12 14 16
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: A loss-on-ignition (LOI) test performed on Sample SB3 indicates an organic content of about 7.3 percent. Moisture content test was performed on a sandy organic silt layer from Sample SB4.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	9.0	752.0
▼ AT END OF BORING:	9.0	752.0
CAVE-IN OF BOREHOLE AT:	9.7	751.3

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

BORING B3

PAGE 1 OF 1
BORING DEPTH: 30 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 762± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
761.5	0.0	5 1/2 inches of ASPHALT PAVEMENT	761.5
	0.5	FILL- Fine to Coarse SAND- Light Brown- Moist (SP)	761.0
	3.5	FILL- Fine to Medium SAND with Silt- Brown to Grayish Brown at 5.5 feet- Moist- Medium Dense to Very Dense (SP-SM)	
	8.0	BURIED TOPSOIL- Fine SILTY to CLAYEY SAND- Black- Moist- Medium Dense (SM/SC)	753.5
	10.5	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Loose to Dense (SP)	751.0
	30.0	END OF BORING AT 30.0 FEET.	732.0

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 4 14 15 / 17 24 27 / 17 17 15 / 8 8 9 / 3 3 4 / 5 12 17 / 7 11 13 / 8 14 12
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: A loss-on-ignition (LOI) test performed on Sample SB4 indicates an organic content of about 10.1 percent.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	10.5	751.5
▼ AT END OF BORING:	10.3	751.7
CAVE-IN OF BOREHOLE AT:	13.0	749.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

BORING B4

PAGE 1 OF 1
BORING DEPTH: 35 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 762± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
762.0	0.0	FILL- Fine SILTY SAND- Brown- Moist- Medium Dense (SM)	759.0
	3.0	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense (SP-SM)	756.5
	5.5	FILL- Fine to Medium CLAYEY SAND- Dark Brown- Moist- Medium Dense (SC)	753.3
	8.7	CLAYEY SILT with Sand- Gray- Hard (ML/CL)	752.3
	9.7	AMORPHOUS PEAT- Black (PT)	749.0
	13.0	Fine to Coarse SAND with Gravel- Brown and Gray- Wet- Medium Dense to Dense (SP)	
	35.0	END OF BORING AT 35.0 FEET.	727.0

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 3 8 / 14 14 / 17 14 / 6 8 8 / 26 35 32 / 16 13 / 12 12 15 / 9 13 17 / 11 20 23
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: A loss-on-ignition (LOI) test performed on the past portion of Sample SB4 indicates an organic content of about 40 percent.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	13.0	749.0
▼ AT END OF BORING:	10.4	751.6
CAVE-IN OF BOREHOLE AT:	11.0	751.0

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.

BORING B5

PAGE 1 OF 1
BORING DEPTH: 35 FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 762± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
762.0	0.0	FILL- Fine to Medium SILTY SAND- Occasional Wood Pieces- Brown- Moist- Medium Dense (SM)	759.0
	3.0	FILL- Fine to Medium SILTY SAND- Frequent Clayey Sand Layers- Gray- Moist- Medium Dense (SM)	756.5
	5.5	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense to Loose (SP-SM)	752.5
	9.5	BURIED TOPSOIL- Fine CLAYEY SAND- Dark Brown to Black- Moist- Loose (SC)	750.0
	12.0	Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Dense (SP)	
	35.0	END OF BORING AT 35.0 FEET.	727.0

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 5 11 / 13 14 14 / 6 12 7 / 5 4 3 / 7 9 11 / 6 11 16 / 9 13 10 / 12 14 9
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: A loss-on-ignition (LOI) test performed on the buried topsoil portion of Sample SB4 indicates an organic content of about 7.2 percent.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ DURING BORING:	12.0	750.0
▼ AT END OF BORING:	Note 4	

BACKFILL METHOD: Note 4

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. No hammer efficiency data was available, and the graphic output illustrates the field measured blow counts.
4. Observation Well OW5 constructed in the borehole upon completion.

WELL OW5

PAGE 1 OF 1
WELL DEPTH 18+/- FEET

PROJECT NAME: KWRP Biofiltration Odor Control
PROJECT NUMBER: 085267.00
CLIENT: City of Kalamazoo
PROJECT LOCATION: Kalamazoo, Michigan
DATE STARTED: 10/12/20 **COMPLETED:** 10/12/20 **BORING METHOD:** Hollow-stem Augers
DRILLER: JC (GLD) **RIG NO.:** CME 75 **LOGGED BY:** AJR **CHECKED BY:** KJG

ELEVATION 762± FT

ELEV (FT)	DEPTH (FT)	PROFILE DESCRIPTION	
762.0	0.0	FILL- Fine to Medium SILTY SAND- Occasional Wood Pieces- Brown- Moist- Medium Dense (SM)	759.0
	3.0	FILL- Fine to Medium SILTY SAND- Gray- Moist- Medium Dense (SM)	756.5
	5.5	FILL- Fine to Medium SAND with Silt- Brown- Moist- Medium Dense to Loose (SP-SM)	752.5
	9.5	BURIED TOPSOIL- Fine CLAYEY SAND- Dark Brown to Black- Moist- Loose (SC)	750.0
	12.0	Fine to Coarse SAND with Gravel- Gray- Wet- Loose to Dense (SP)	
	35.0	END OF BORING AT 35.0 FEET.	727.0

WELL DIAGRAM
-2.2 FT (RIM)
2-inch diameter Riser Pipe with Expandable Pressure Cap
Top of Riser Pipe Elevation = 764.28 feet
Auger Cuttings
2-inch diameter Flush Threaded Sch. 40 PVC Well Casing, 10.3 feet long
Bentonite Chips
Well Sand
6 3/4 inch diameter Borehole
2-inch diameter Sch. 40 PVC with 0.010-inch Slot Size Well Screen, 10 feet long
Bottom Plug

SAMPLE TYPE/NO.: 881, 882, 883, 884, 885, 886, 887, 888, 889
RECOVERY (INCHES): 18 each
STRATIGRAPHIC LOG NOTES: 6 8 8 8 / 8 8 6 6 / 5 4 4 5 / 1 1 2 3 / 6 7 10 12 / 7 8 10 12 / 9 10 11 12 / 11 12 14 16
HAMMER EFFICIENCY: 60% DATE:
N_{60} = 10 20 30 40
DRY DENSITY (pcf): 80 100 110 120
MOISTURE & ATTERBERG LIMITS (%): PL MC LL; 10 20 30 40
HAND PENE. TORVANE SHEAR. UNC COMP. VANE SHEAR (PK) VANE SHEAR (REM) TRIAXIAL (UU SHEAR STRENGTH (KSF))

REMARKS: A loss-on-ignition (LOI) test performed on Sample SB3 indicates an organic content of about 7.3 percent. Moisture content test was performed on a sandy organic silt layer from Sample SB4.

GROUNDWATER INFORMATION

WELL WATER LEVEL DATA

DATE	DEPTH (FT)	ELEV (FT)
8/5/2021	11.27	733.01

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. Observation well OW5 constructed in the borehole of boring B5 upon completion. See the log for boring B5 for more information on sampling details and the soil profile description.
4. Depth to groundwater measured from the top of casing.

THE CITY OF Kalamazoo

GEOTECHNICAL DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
1		
2		
3		
4		
5		

REVISIONS AFTER ISSUED FOR BID

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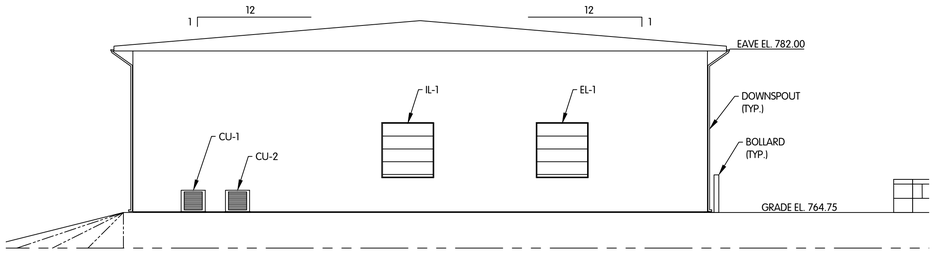
JOB NO. 017-7725.001
SCALE NONE
THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
ADK	CJAF	AJD

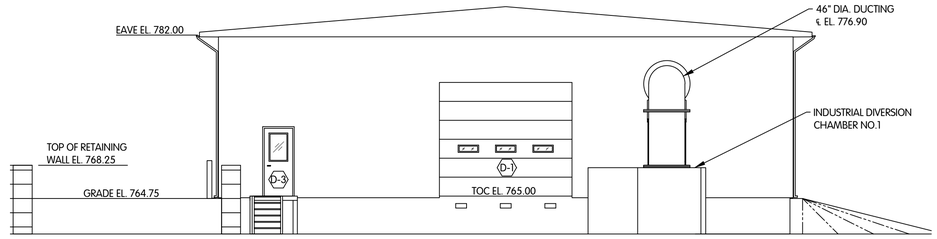
STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022

SHEET NO.
C-7
12 OF 44

KAL-77250\ICGS-GEOTECHNICAL DETAILS
10/28/2022 2:14 PM - SWILLIS
10/28/2022 2:10 PM



EAST ELEVATION



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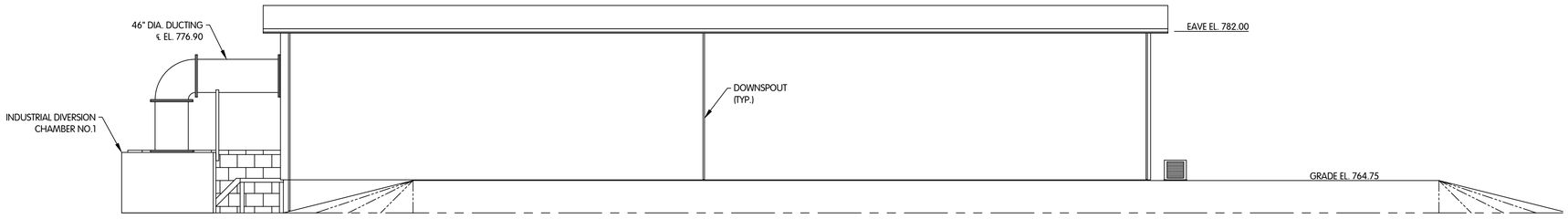

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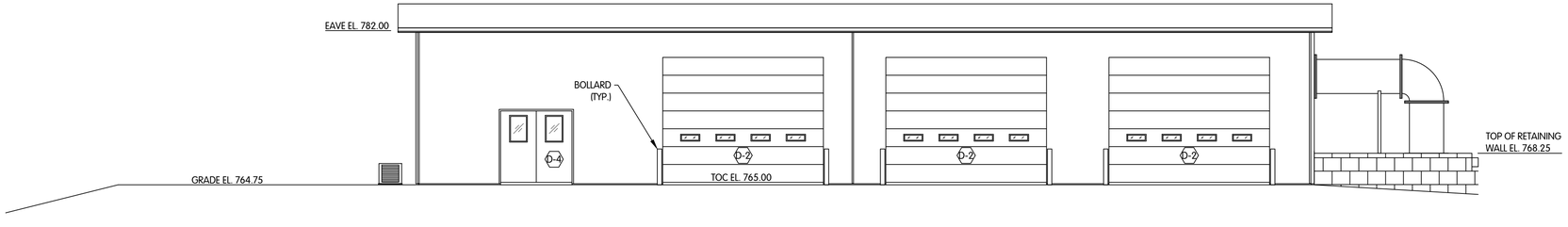

NORTH ELEVATION

THE CITY OF Kalamazoo

BLOWER BUILDING ARCHITECTURAL VIEWS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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JOB NO. 017-7725.001

SCALE 1/8" = 1'-0"

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
KDB	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

A-1

13 OF 44

K:\KAL-7725001\A01-BLOWER BUILDING ARCHITECTURAL VIEWS
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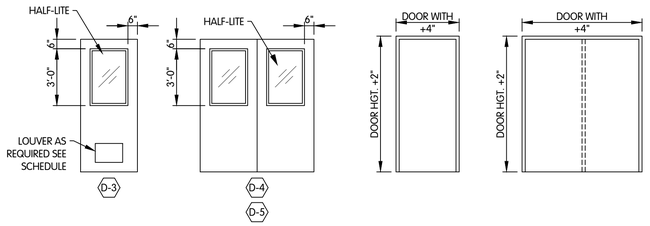
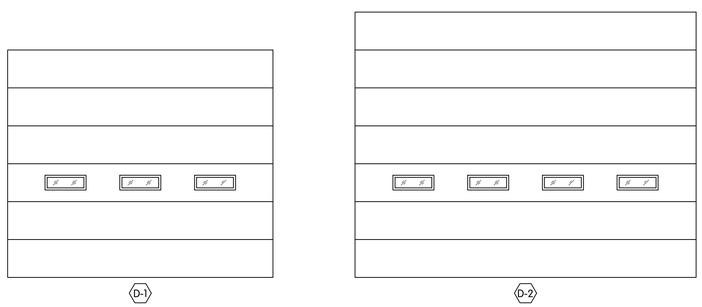
1/27/2022 2:31 PM





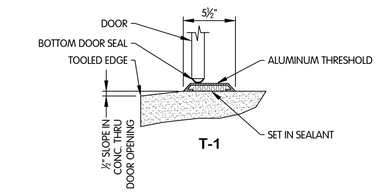
DOOR TYPES

1/4"=1'-0"

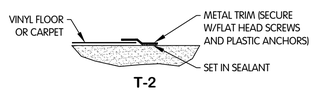
DOOR SCHEDULE

		DOOR					DETAILS					
TAG ID.	QTY.	WIDTH	HEIGHT	THICKNESS	TYPE	MAT.	HEAD	JAMB	THRESH	FRAME MAT.	GLAZING	UL LABEL
D-1	1	14'-0"	12'-0"	2"	ROLL UP	STEEL	H-10	J-10	T-3	GALV. STEEL	N/A	325
D-2	3	18'-0"	14'-0"	2"	OD	STEEL	H-10	J-10	T-3	GALV. STEEL	N/A	325
D-3	1	3'-0"	7'-2"	1 3/4"	HL	ALUMINUM	H-9	J-9	T-1	ALUMINUM	SAFETY	N/A
D-4	3	8'-0"	8'-0"	1 3/4"	HL	ALUMINUM	H-9	J-9	T-1	ALUMINUM	SAFETY	N/A
D-5	2	8'-0"	7'-2"	1 3/4"	HL	ALUMINUM	H-9	J-9	T-1	ALUMINUM	SAFETY	N/A

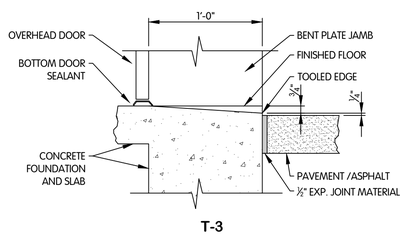
NOTE: HEADER AND JAMB DETAILS FOR PRE-ENGINEERED METAL BUILDING MAY DIFFER THAN SHOWN PER MANUFACTURER DETAILS. IF DETAILS DIFFER CONTRACTOR SHALL FOLLOW DETAILS AS PROVIDED BY BUILDING MANUFACTURER



T-1



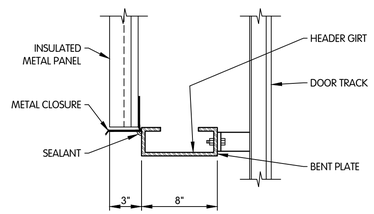
T-2



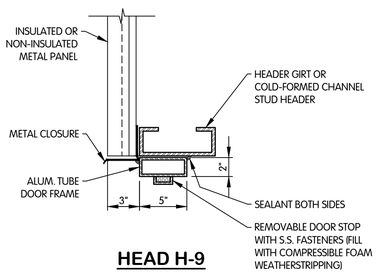
T-3

THRESHOLD TYPES

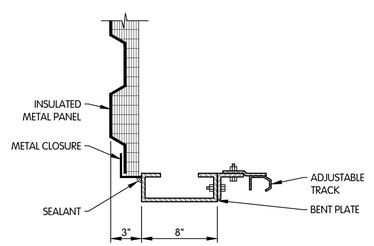
1½"=1'-0"



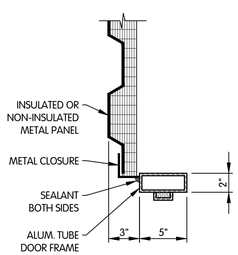
HEAD H-10



HEAD H-9



JAMB J-10



JAMB J-9

JAMB TYPES

1½"=1'-0"

STRUCTURAL DESIGN DATA

BUILDING CODE		2018 MICHIGAN BUILDING CODE
OCCUPANCY CATEGORY		= III
USE GROUP		= F-2
CONSTRUCTION TYPE		= 2-B
FLOOR	LIVE LOAD, UNLESS NOTED OTHERWISE	= 250 PSF
FLAT ROOF	LIVE LOAD	= 20 PSF (MIN.)
	MECHANICAL & ELECTRICAL	= 10 PSF
SNOW	GROUND SNOW LOAD	= P_G = 35 PSF
	FLAT ROOF	= P_f = 32 PSF
	SNOW EXPOSURE FACTOR	= C_e = 1.0
	SNOW LOAD IMPORTANCE FACTOR	= I_s = 1.1
	THERMAL FACTOR	= C_t = 1.0
WIND	BASIC WIND SPEED	= 120 MPH
	WIND EXPOSURE	= C
SEISMIC	SEISMIC IMPORTANCE FACTOR	= IE = 1.25
	SITE CLASS	= D
	SEISMIC DESIGN CATEGORY	= B
	DESIGN SPECTRAL RESPONSE ACCELERATIONS	= S_{DS} = 0.123 S_{D1} = 0.086
	ANALYSIS PROCEDURE	= EQUIVALENT LATERAL FORCE
STAIRS	LIVE LOAD, UNLESS NOTED OTHERWISE	= 100 PSF
GRATING	LIVE LOAD, UNLESS NOTED OTHERWISE	= 100 PSF
PLATFORM	LIVE LOAD, UNLESS NOTED OTHERWISE	= 100 PSF
SOILS	DESIGN BEARING CAPACITY	= 2500 PSF
CONCRETE	DESIGN STRENGTH AT 28 DAY	= 4500 PSI

GENERAL STRUCTURAL NOTES:

1. ALL CONSTRUCTION JOINTS IN WALLS AND BASE SLABS OF STRUCTURES THAT CONTAIN OR CONVEY LIQUIDS, OR CONTAIN EQUIPMENT OR OCCUPANTS, THAT ARE BELOW GRADE OR 100 YEAR FLOOD, SHALL HAVE CONTINUOUS WATERSTOPS TO MAKE THE STRUCTURE WATERTIGHT. JOIN THE WATERSTOPS AT ALL INTERSECTIONS SO THAT A CONTINUOUS SEAL IS PROVIDED. WATERSTOPS SHALL BE SECURED RIGIDLY IN THEIR DESIGN LOCATIONS DURING CONCRETE PLACEMENT. VIBRATE CONCRETE TO CONSOLIDATE IT AROUND THE WATERSTOPS.
2. LAP SPLICES, CONSTRUCTION JOINT DETAILS, WALL CORNER REINFORCEMENT DETAILS, JOINT SEALING DETAILS, SHEAR KEY DETAILS, ETC., UNLESS OTHERWISE SHOWN ON THE DRAWINGS, SHALL ADHERE TO STANDARD STRUCTURAL DETAIL DRAWINGS.
3. THE CONTRACTOR SHALL MAINTAIN ADEQUATE SUPERVISION AND CONTROL OF DEWATERING OPERATIONS TO ENSURE THAT STABILITY OF EXCAVATED AND CONSTRUCTED SLOPES ARE NOT ADVERSELY AFFECTED BY INFLOW OF GROUNDWATER AND TO PERMIT PLACEMENT AND CURING OF CONCRETE UNDER CONTROLLED ENVIRONMENTS.
4. CONCRETE MAT AND WALL CONSTRUCTION JOINTS SHALL NOT BE SPACED MORE THAN 60 FEET APART, UNLESS NOTED OTHERWISE. WHEN CONSTRUCTION JOINT SPACING EXCEEDS 25 FEET THE PLACEMENT OF CONCRETE SECTIONS SHALL BE ALTERNATED TO ALLOW ADJACENT SECTIONS TO BE PLACED AT LEAST 48 HOURS APART. THIS ALLOWS FOR SHRINKAGE TO OCCUR IN A SECTION PRIOR TO THE PLACEMENT OF ITS ADJACENT SECTIONS. HORIZONTAL REINFORCEMENT SPLICES SHALL BE LOCATED IN THE ADJACENT SECTION THAT WILL BE PLACED AT LEAST 48 HOURS LATER TO ALLOW FOR UNRESTRAINED SHRINKAGE TO OCCUR BETWEEN PLACED SECTIONS. JOINT TYPES AND LOCATION PLANS SHALL BE SUBMITTED WITH REBAR SHOP DRAWINGS FOR ENGINEER'S REVIEW.
5. BACKFILL SHALL NOT BE PLACED AGAINST CONCRETE TANK OR RETAINING WALLS PRIOR TO PLACEMENT OF TOP SLAB AND ADJACENT WALLS, AND SHALL NOT BE BACKFILLED PRIOR TO 28 DAYS AFTER PLACEMENT, UNLESS IT IS DEMONSTRATED THAT FIELD CURED TEST SPECIMENS HAVE REACHED THE CONCRETE DESIGN STRENGTH, OR CONTRACTOR INSTALLS ADEQUATE SHORING. SHORING SHALL BE THE CONTRACTORS RESPONSIBILITY AND INSTALLED AT NO COST TO OWNER.
6. THE BACKFILL UNDERNEATH BASE SLABS AND FOOTINGS SHALL BE SPECIAL BACKFILL, UNLESS OTHERWISE APPROVED, IN ACCORDANCE WITH THE SPECIFICATIONS AND SHALL BE WELL COMPACTED TO NOT LESS THAN 100% MAXIMUM DRY DENSITY IN ACCORDANCE WITH THE STANDARD PROCTOR TEST ASTM D-698 AND SPECIFICATION 02200.
7. WHEREVER REINFORCEMENT REQUIREMENTS FOR STRUCTURAL COMPONENTS (BEAMS, SLABS, WALLS, ETC.) DON'T AGREE AMONG DIFFERENT SECTIONS, THE MOST CONSERVATIVE REQUIREMENT AMONG THEM WILL GOVERN, UNLESS OTHERWISE APPROVED BY THE ENGINEER.
8. IF NOT OTHERWISE SHOWN OR SPECIFIED ALL WALL VERTICAL REINFORCING SHALL BE DOWELED INTO BASE MATS, ALL WALL HORIZONTAL REINFORCING SHALL BE DOWELED WITH EITHER INTERSECTION OR CORNER BARS TO ADJACENT WALLS, AND ALL SLAB HORIZONTAL REINFORCING SHALL BE DOWELED INTO ADJACENT WALLS, WITH REINFORCING THAT MATCHES THE GIVEN REINFORCEMENT. IF NOT OTHERWISE SHOWN OR SPECIFIED, CONCRETE SECTIONS SHALL BE HORIZONTALLY AND VERTICALLY REINFORCED WITH #5 BARS AT 12" C/C, EACH WAY AND EACH FACE.
9. WHENEVER THICKNESSES OF STRUCTURAL COMPONENTS (WALLS, SLABS, BEAMS, ETC.) DON'T AGREE AMONG DIFFERENT SECTIONS, THE THICKEST SECTION AMONG THEM THEN SHALL GOVERN, UNLESS OTHERWISE APPROVED BY THE ENGINEER.
10. VERIFY ALL EXISTING DIMENSIONS, ELEVATIONS AND CONDITIONS AT INTERFACE BETWEEN EXISTING & NEW CONSTRUCTION BEFORE STARTING TO FABRICATE STRUCTURAL STEEL OR DETAILING REBARS. NOTIFY THE ENGINEER OF ANY DISCREPANCIES FOR RESOLUTION.
11. DURING CONSTRUCTION OF NEW STRUCTURES OR STRUCTURAL ELEMENTS, PREVENT UNDERMINING THE FOUNDATIONS OF NEARBY EXISTING STRUCTURES BY SHEET PILING OR BY UNDERPINNING AS REQUIRED. TAKE ALL NECESSARY PROTECTIVE MEASURES TO PREVENT DAMAGE TO THE EXISTING STRUCTURES. CAREFULLY MONITOR THE SETTLEMENT OF EXISTING STRUCTURES DURING SHEET PILING OR UNDERPINNING OPERATIONS. CONTRACTOR IS RESPONSIBLE FOR THE DESIGN OF SHEET PILING OR UNDERPINNING OPERATIONS & SHALL SUBMIT THIS PROCEDURE TO THE ENGINEER FOR REVIEW.
12. THE CONTRACTOR SHALL ENSURE THAT FOUNDATIONS REST ON FIRM MATERIAL OVER THEIR ENTIRE AREA. THE TESTING LAB SHALL VERIFY THAT A SOIL BEARING CAPACITY OF THAT LISTED BY THE "STRUCTURAL DESIGN DATA" TABLE IS OBTAINED. THE BEARING CAPACITY VERIFICATION IS REQUIRED AT REGULAR INTERVALS IN EACH DIRECTION. NOTIFY THE ENGINEER OF ANY UNSUITABLE SOIL ENCOUNTERED. SUCH SOIL SHALL BE REMOVED AND REPLACED WITH COMPACTED SPECIAL BACKFILL AS DIRECTED BY THE ENGINEER.
13. ALL TREATED WOOD SHALL BE SECURED WITH STAINLESS STEEL OR HOT DIP GALVANIZED FASTENERS.
14. WHERE SAW CUTTING CONCRETE LEAVES SURFACE EXPOSED IN OR ABOVE LIQUID CONTAINING OR CONVEYING STRUCTURES, OR WHERE SPECIFICALLY CALLED FOR ELSEWHERE, APPLY " SIKA ARMATEC 110 EPOCEM" TO EXPOSED REINFORCING. THEN APPLY "SIKATOP 121 PLUS" OR " SIKATOP 122 PLUS" TO LEVEL THE SURFACE. THEN APPLY TWO COATS OF "SIKA GUARD 62" (20 MILS EACH) PROTECTIVE COATING. APPLICATIONS SHALL BE ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. USE THESE PRODUCTS OR ENGINEER APPROVED EQUAL.
15. ALL RAILING SYSTEMS SHALL BE ALUMINUM, UNLESS NOTED OTHERWISE.
16. CHAMFER STRIPS SHALL BE PLACED IN CORNERS OF FORMS AND AT ALL EXPOSED EDGES TO PRODUCE A BEVELED EDGE ON PERMANENTLY EXPOSED SURFACES. CHAMFERS SHALL BE ¾ - INCH OR AS NOTED ON DRAWINGS. CHAMFER STRIPS SHALL BE WOOD, METAL, PVC, OR RUBBER AND SHALL BE FABRICATED AND INSTALLED TO PRODUCE UNIFORMLY SMOOTH AND STRAIGHT LINES. CHAMFER STRIPS SHALL BE MITERED AT CHANGES IN DIRECTION.
17. PATCH ALL VISIBLE CONCRETE THAT GETS DAMAGED, CREATES LARGE DEPRESSIONS OR UNEVEN SURFACES FROM THE REMOVAL OF EXISTING BUILDING ELEMENTS, EQUIPMENT, EQUIPMENT BASES OR UTILITIES PER THE CONCRETE RESTORATION SPECIFICATIONS 03710, UNLESS NOTED OTHERWISE. PATCH SMALL ANCHOR HOLES FROM REMOVED EQUIPMENT OR UTILITIES WITH NON-SHRINK GROUT, UNLESS NOTED OTHERWISE.
18. CONTRACTOR SHALL ADD CONCRETE REINFORCEMENT DOWEL BAR REPLACEMENTS (DBR'S) WHERE REQUIRED TO FACILITATE CONSTRUCTION. LOCATION OF DBR'S REQUIRE ENGINEER'S APPROVAL.

THE CITY OF Kalamazoo

STRUCTURAL
DESIGN DATA, GENERAL NOTES & DOOR DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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JOB NO. 017-7725.001

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KDB	CJAF	AJD

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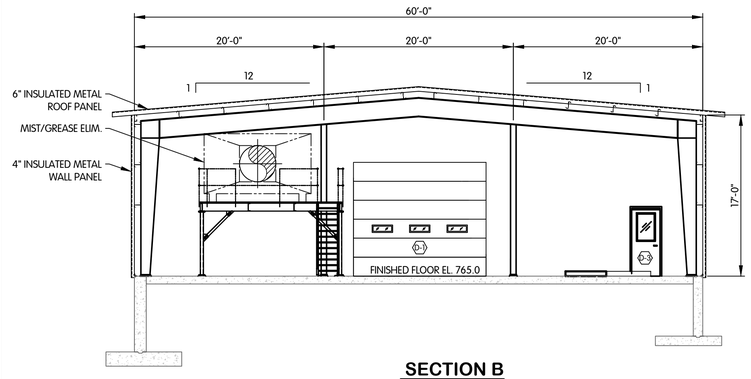
DATE: FEBRUARY 2022

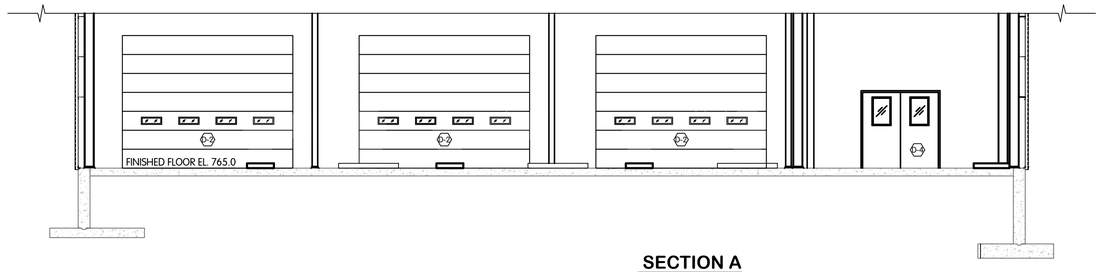
SHEET NO.
S-1
14 OF 44

KAL-7725001SDA-STRUCTURAL DESIGN DATA GENERAL NOTES & DOOR DETAILS
2/28/2022 2:31 PM - SWILLIS

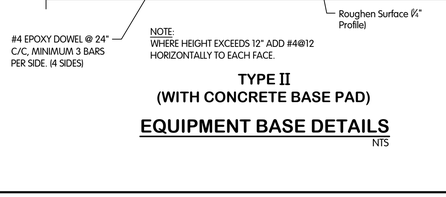
NOTE:
1. MECHANICAL AND ELECTRICAL ROOMS SHALL BE FULL HEIGHT 6" METAL STUD WALLS WITH METAL SIDING PANEL. BLOCKING SHALL BE ADDED AS REQUIRED TO MOUNT EQUIPMENT.
2. ADDITIONAL BUILDING FRAMING SHALL BE INSTALLED, AS REQUIRED, TO SUPPORT MECHANICAL AND ELECTRICAL EQUIPMENT ON WALLS AND AT WALL PENETRATIONS.
3. PIPE BOLLARDS W/ COVERS SHALL BE INSTALLED AT EACH SIDE OF OVERHEAD DOORS ON NORTH SIDE OF BUILDING. (2) BOLLARDS PER DOOR TYP.
4. DOCK BUMPERS SHALL BE INSTALLED ON WEST SIDE OVERHEAD DOOR.



SECTION B

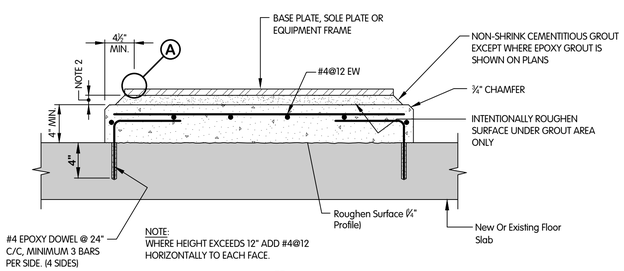


SECTION A



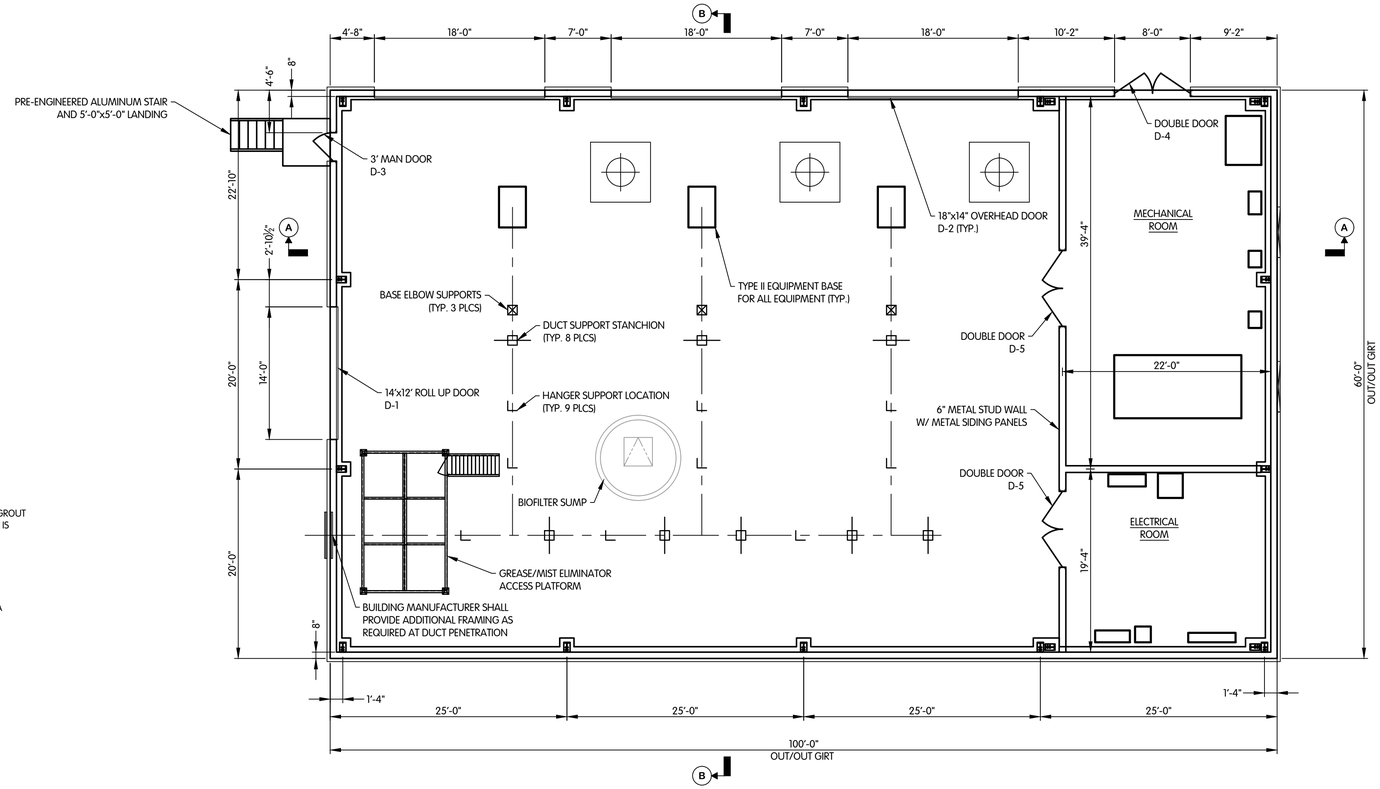
DETAIL A
(TYPICAL) NTS

EQUIPMENT BASE NOTES:
1. CONCRETE BASE PAD DIMENSIONS SHALL BE 4" LARGER THAN FURNISHED EQUIPMENT BASE ON ALL SIDES, UNLESS NOTED OTHERWISE.
2. GROUT THICKNESS UNDER EQUIPMENT BASES SHALL BE AS FOLLOWS:
   A). 3" MAX. UNLESS NOTED OTHERWISE.
   B). 1" MIN. FOR NON-SHRINK CEMENTITIOUS GROUT, U.N.O.
   C). 2" MIN. FOR EPOXY GROUT, U.N.O.
3. WHEN BASE IS ON ELEVATED SLAB THE SLAB BARS SHALL NOT BE CUT. USE REBAR FINDER EQUIPMENT TO LOCATE BARS AND ADJUST ANCHORAGE LOCATIONS TO MISS FLOOR BARS.



TYPE II
(WITH CONCRETE BASE PAD)

EQUIPMENT BASE DETAILS
NTS



KAL-7725001SH-BLOWER BUILDING STRUCTURE PLAN
1/28/2022 2:31 PM - SWILLIS

THE CITY OF Kalamazoo

BLOWER BUILDING STRUCTURE PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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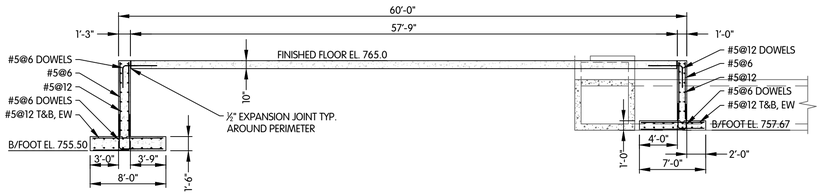
DESIGNED	KDB
DRAWN	CJAF
CHECKED	AJD
STATUS:	ISSUED FOR BID
DATE:	FEBRUARY 2022
SHEET NO.	S-2
	15 OF 44

BLOWER BUILDING STRUCTURAL REINFORCING NOTES:

1. BUILDING SLAB SHALL BE 10" SLAB WITH #6 BARS @ 12" TOP AND BOTTOM, EACH WAY.
2. ALL FOOTINGS AND SLABS SHALL BE POURED ON 8" MIN. COMPACTED SPECIAL BACKFILL.
3. ALL BARS SHALL INCLUDE MATCHING DOWELS AND CORNER BARS.
4. ADDITIONAL REINFORCEMENT WILL BE REQUIRED AT ALL WALL AND SLAB OPENINGS.
5. COLUMN PIERS SHALL HAVE #4 TIES @ 10" TYP. WITH TOP (4) TIES @ 3".
6. ALL COLUMN PIERS SHALL HAVE TYPICAL ADDITIONAL PIER REINFORCING, SEE DETAIL.



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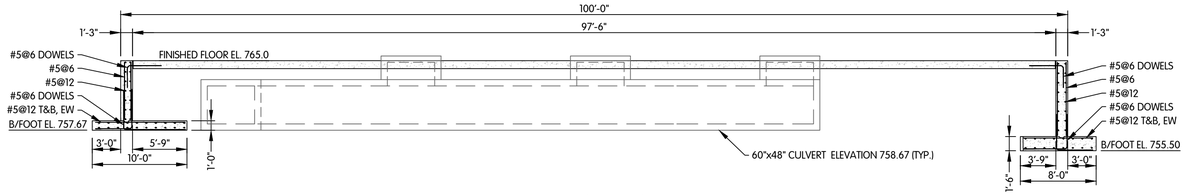
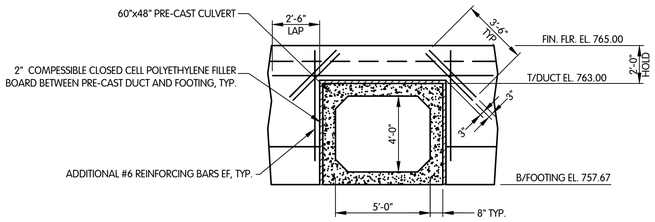
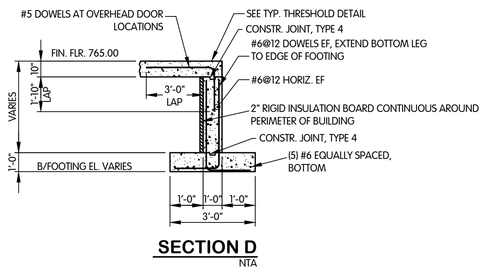


SECTION A



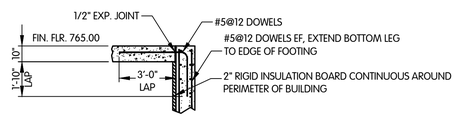
SECTION C
1/4" = 1'-0"

NOTE: BUILDING SLAB REINFORCING NOT SHOWN FOR CLARITY

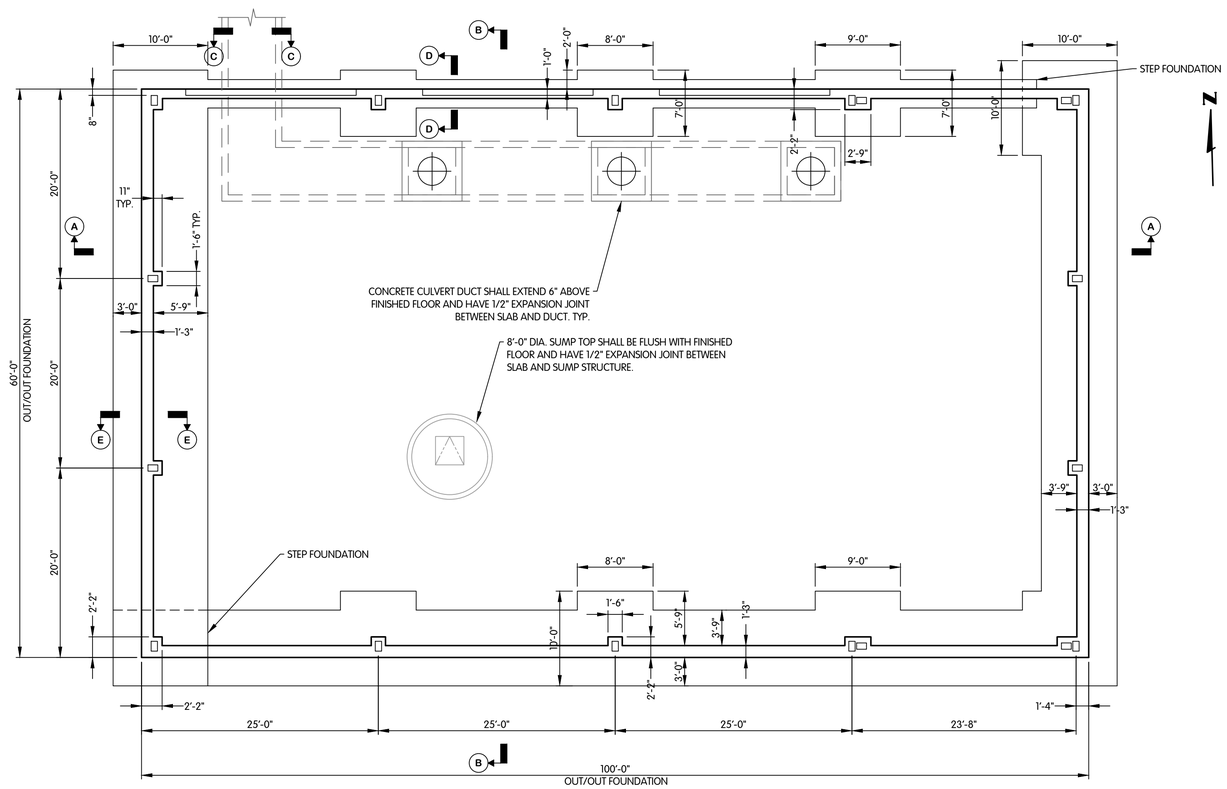


SECTION D
NTA

NOTE: BUILDING SLAB REINFORCING NOT SHOWN FOR CLARITY



SECTION E
1/4" = 1'-0"



THE CITY OF Kalamazoo

BLOWER BUILDING FOUNDATION PLAN & DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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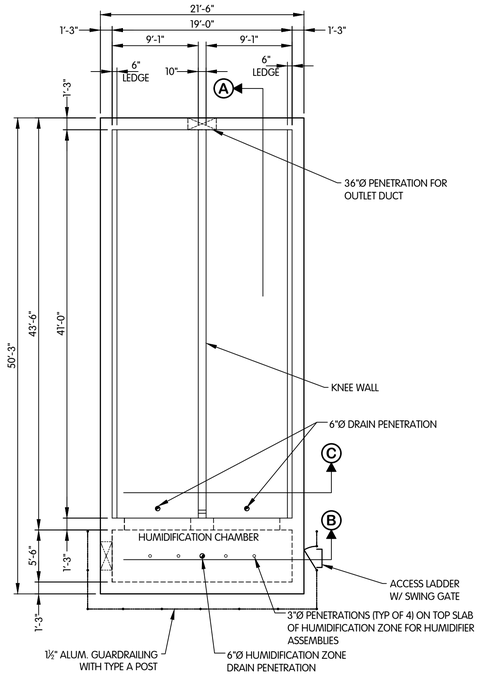
K:\KAL-77250\ISSD2-BLOWER BUILDING FOUNDATION PLAN & DETAILS
1/27/2022 1:39 PM - SWILLIS
1/27/2022 1:39 PM

GENERAL BIOBED NOTES:

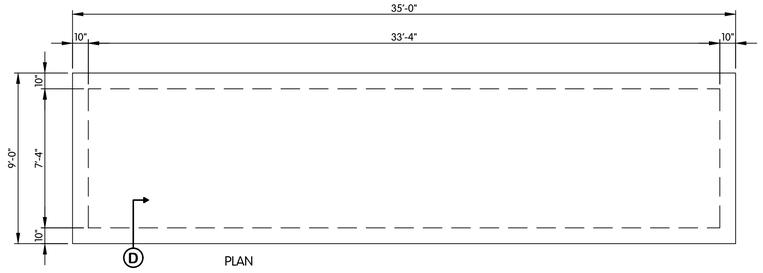
1. REFER TO PROJECT PLANS FOR ACTUAL ORIENTATION, QUANTITY AND LOCATION.
2. CONTRACTOR TO SUPPLY AND INSTALL ALL EMBEDDED ITEMS AS REQUIRED FOR ALL PLUMBING, DUCTING, AND ELECTRICAL COMPONENTS, UNLESS NOTED OTHERWISE.
3. AIR TIGHT MAN DOOR CAST IN CONCRETE, 18" ABOVE FLOOR SURFACE AS SHOWN.
4. BIOBED COVER SHALL BE ANCHORED AND SEALED TO BIOBED STRUCTURE AS OUTLINED BY COVER MANUFACTURER.
5. ALL FOOTINGS AND SLABS SHALL BE POURED ON 8" MINIMUM COMPACTED SPECIAL BACKFILL.

BIOBED STRUCTURE REINFORCING NOTES:

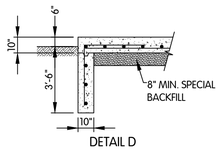
1. TANK WALLS SHALL BE REINFORCED WITH #7 BARS @ 6" EACH WAY AND EACH FACE.
2. TANK SLAB SHALL BE REINFORCED WITH #7 BARS @ 6" EACH WAY AND EACH FACE.
3. HUMIDIFICATION CHAMBER TOP SLAB SHALL BE REINFORCED WITH #7 BARS @ 12" EACH WAY AND EACH FACE.
4. ALL BARS SHALL INCLUDE MATCHING DOWELS AND CORNER BARS.
5. ADDITIONAL REINFORCEMENT WILL BE REQUIRED AT ALL WALL AND SLAB OPENINGS.
6. WATERSTOPS SHALL BE INCLUDED AT EACH CONSTRUCTION AND CONTROL JOINT AND WHERE SPECIFIED BY FINAL DESIGN.



PLAN



PLAN

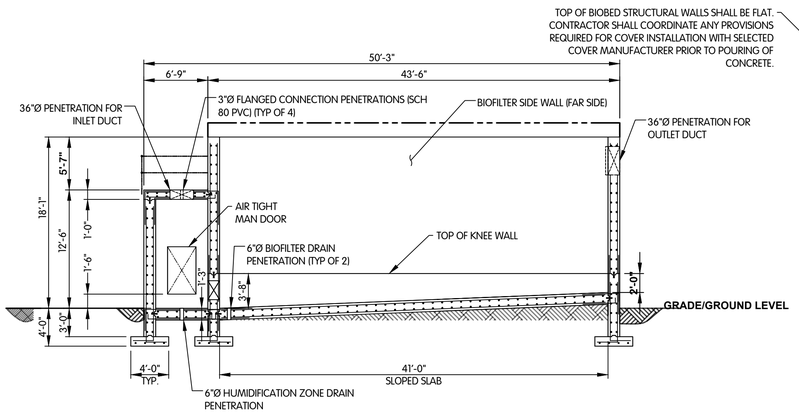


DETAIL D

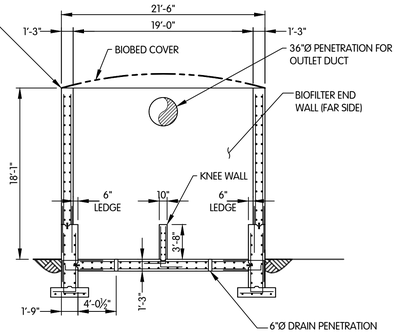
NOTE:
PAD DIMENSIONS ARE MINIMUM AND MUST BE VERIFIED WITH EQUIPMENT SUPPLIED PRIOR TO CONSTRUCTION. PAD SHALL BE MINIMUM 12" LARGER THAN EQUIPMENT BASE ON ALL SIDES.

CARBON SCRUBBER PAD DETAIL

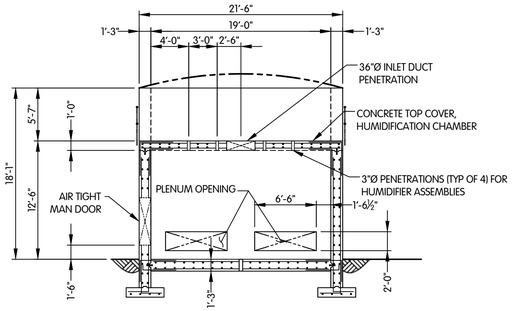
1/4" = 1'-0"



SECTION A



SECTION C



SECTION B
HUMIDIFICATION CHAMBER

BIOFILTER DETAILS

1/8" = 1'-0"

KAL-7725001S03-BIOFILTER & CARBON SCRUBBER PAD STRUCTURAL DETAILS
2/28/2022 2:51 PM - SWILLIS

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BIOFILTER & CARBON SCRUBBER PAD STRUCTURAL DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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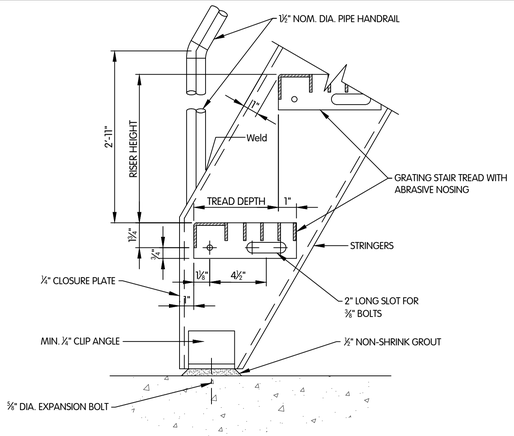
DATE: FEBRUARY 2022

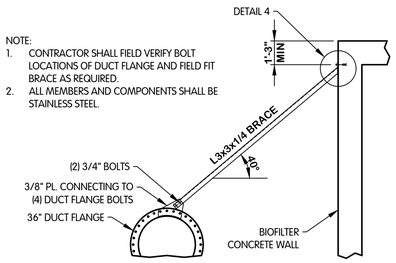
SHEET NO.

S-4

17 OF 44

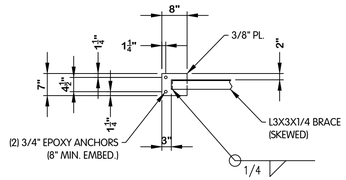


SHIP LADDER DETAIL
NTS

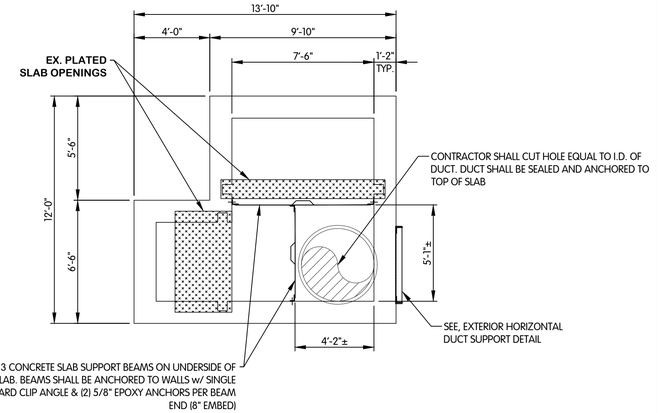


NOTE:
1. CONTRACTOR SHALL FIELD VERIFY BOLT LOCATIONS OF DUCT FLANGE AND FIELD FIT BRACE AS REQUIRED.
2. ALL MEMBERS AND COMPONENTS SHALL BE STAINLESS STEEL.

TYP. 36" DUCT BRACE SUPPORT DETAIL
1/4"=1'-0"

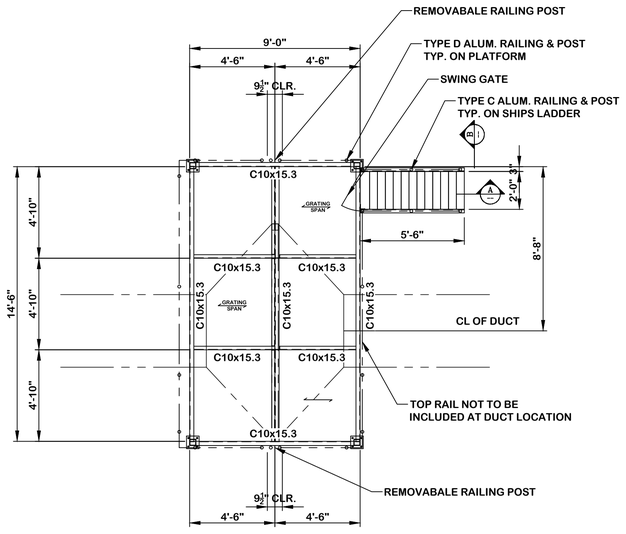


DETAIL 4
1/2"=1-0"



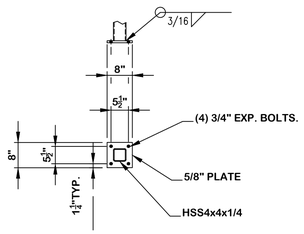
DIVERSION CHAMBER SLAB SHORING
NTS

NOTE:
1. CONTRACTOR SHALL EVALUATE INTERIOR CONDITIONS OF CHAMBER ESPECIALLY AT BEAM ANCHORAGE LOCATION AND HOLE CORE LOCATION PRIOR TO WORK. IF CRACKS OR QUESTIONABLE CONDITIONS ARE OBSERVED CONTACT ENGINEER AND DO NOT PROCEED UNTIL DIRECTION IS GIVEN.
2. ALL STEEL COMPONENTS INSIDE CHAMBER SHALL BE 316 S.S. U.N.O.
3. CONTRACTOR SHALL FIELD LOCATE DUCT PENETRATION LOCATION AS CLOSE TO SOUTH EAST CORNER OF CHAMBER AS REASONABLE.

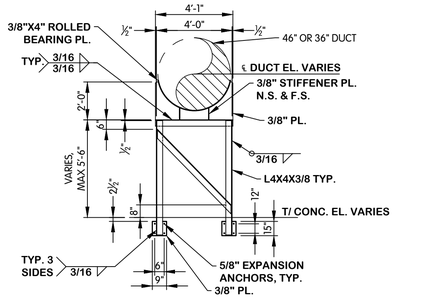


GREASE & MIST ELIMINATOR PLATFORM PLAN
1/4"=1'-0"

NOTE: CONTRACTOR SHALL FIELD VERIFY PLATFORM ELEVATION WITH SELECTED GREASE/MIST ELIMINATOR DIMENSIONS TO ENSURE EQUIPMENT REST ON GRATING. GROUT PADS BELOW COLUMNS CAN BE VARIED BUT SHALL BE BETWEEN 1/2" AND 1 1/2" THICK.

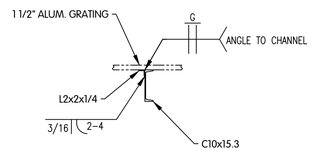


DETAIL 1
1/2"=1-0"



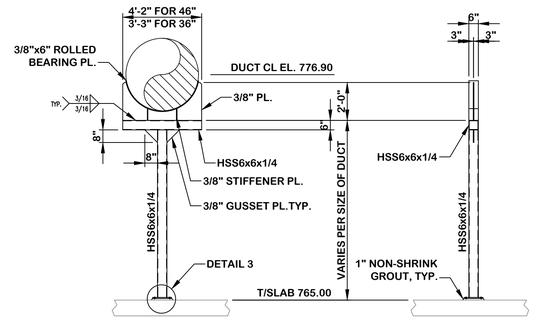
EXTERIOR HORIZONTAL DUCT SUPPORT DETAIL
NTS

NOTE:
1. CONTRACTOR SHALL FIELD VERIFY DUCT AND SLAB ELEVATION
2. ALL MATERIALS AND COMPONENTS SHALL BE GALV. STEEL.



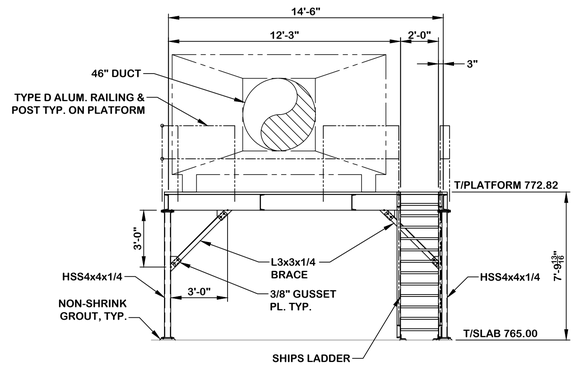
DETAIL 2
1/2"=1-0"

DETAIL 3
1/2"=1-0"



NOTE: STANCHION SUPPORTS SHALL NOT BE SPACED MORE THAN 8'-0" APART UNLESS SPECIFICALLY NOTED OTHERWISE. WHERE A GREATER SPAN BETWEEN SUPPORTS IS DESIRED A HANGER CAN BE USED IN PLACE OF THE STANCHION. IF THIS DONE STANCHION SUPPORTS SHALL NOT EXCEED 16'-0" SPACING. ADDITIONAL HEADER STEEL MAYBE REQUIRED FOR HANGER MOUNTING.

TYPICAL DUCT SUPPORT STANCHION
1/4"=1'-0"



SECTION A
1/4"=1'-0"

SECTION B
1/4"=1'-0"

KAL-772500\S00-GREASE MIST ELIMINATOR PLATFORM & STRUCTURAL DETAILS
1/28/2022 2:31 PM - SWILLIS

THE CITY OF Kalamazoo

GREASE MIST ELIMINATOR PLATFORM & STRUCTURAL DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
1	REVISIONS AFTER ISSUED FOR BID	

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JOB NO.	017-7725.001
SCALE	1/4" = 1'-0"

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
KDB	CJAF	AJD

STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022

SHEET NO.
S-5
18 OF 44

TYPICAL CONCRETE COVER

CONCRETE CAST AGAINST EXPOSED EARTH	3"
SURFACE EXPOSED TO EARTH OR WEATHER	2"
SURFACE EXPOSED TO OR OVER WATER, SEWAGE, OR OTHER LIQUIDS	
SLABS, WALLS, JOISTS:	2"
BEAMS, COLUMNS	
PRIMARY REINFORCEMENT:	2½"
STIRRUPS AND TIES:	2"
OTHER SURFACES	
SLABS, WALLS, JOISTS:	1"
BEAMS, COLUMNS,	
PRIMARY REINFORCEMENT:	2"
STIRRUPS AND TIES,	1½"

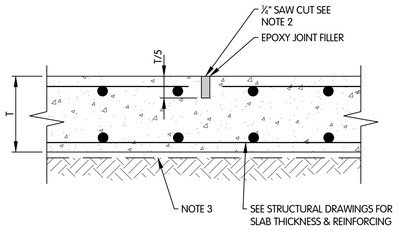
NT DETAILS

RE SHOWN ON DRAWINGS OR SPECIFIED.
LIQUID CONTAINING STRUCTURES, UNLESS NOTED OTHERWISE.
CES PER SPEC. 03300.

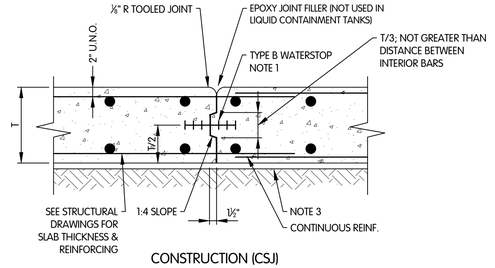
LAP SPLICE LENGTH (IN.) UNLESS SHOWN OTHERWISE

BAR SIZE	CLEAR COVER 2" OR MORE		CLEAR COVER LESS THAN 2"	
	TOP REINFORCEMENT	BOTTOM AND VERTICAL REINFORCEMENT	TOP REINFORCEMENT	BOTTOM AND VERTICAL REINFORCEMENT
#3	18	16	18	16
#4	24	19	24	19
#5	30	23	30	23
#6	36	28	40	31
#7	42	33	54	42
#8	51	39	71	55

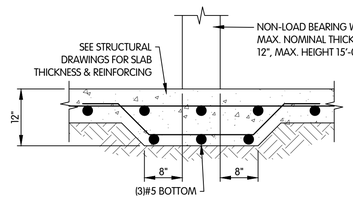
NOTE:
TOP REINFORCEMENT IS DEFINED AS HORIZONTAL REINFORCEMENT WITH MORE THAN 12" OF FRESH CONCRETE CAST BENEATH THE BAR. HORIZONTAL BARS IN WALLS SHALL BE CONSIDERED AS TOP REINFORCEMENT.



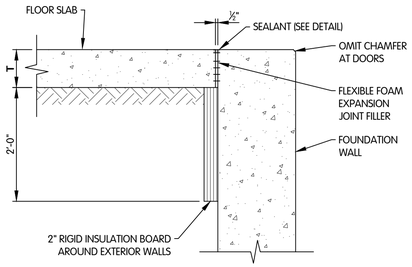
CONTROL JOINT (CJ)



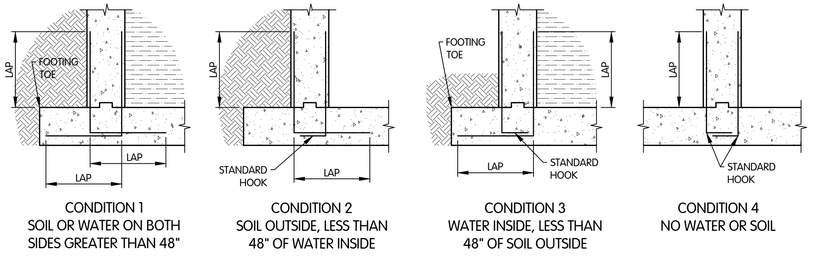
CONSTRUCTION (CSJ)



THICKENED SLAB AT WALLS



PERIMETER ISOLATION JOINT



CONDITION 1
SOIL OR WATER ON BOTH SIDES GREATER THAN 48"

CONDITION 2
SOIL OUTSIDE, LESS THAN 48" OF WATER INSIDE

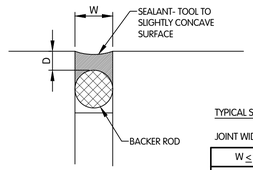
CONDITION 3
WATER INSIDE, LESS THAN 48" OF SOIL OUTSIDE

CONDITION 4
NO WATER OR SOIL

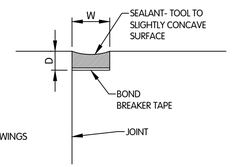
NOTES:
1. WHERE LAP LENGTH HOOK IS INDICATED AND SLAB TOE LENGTH IS NOT LONG ENOUGH FOR LAP HOOK, REDUCE HOOK LENGTH TO TOE LENGTH MINUS 2" COVER.

STANDARD CONCRETE WALL REINFORCEMENT DOWELS TO BASE SLAB

NTS



STANDARD



SHALLOW

TYPICAL SEALANT NOTES:

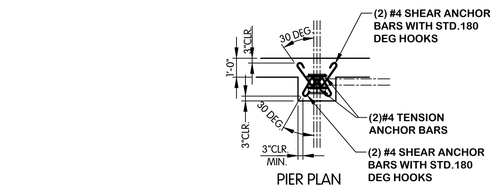
JOINT WIDTH (W) AS SHOWN ON DRAWINGS

W ≤ ½"	D = ¼"
W = ½"	D = ¾"
W ≥ 1"	D = ½"

1. BLUNT SHARP EDGES OF CONCRETE JOINTS WITH GRINDER BEFORE SEALING.

TYPICAL SEALANT DETAILS

NTS



PIER PLAN

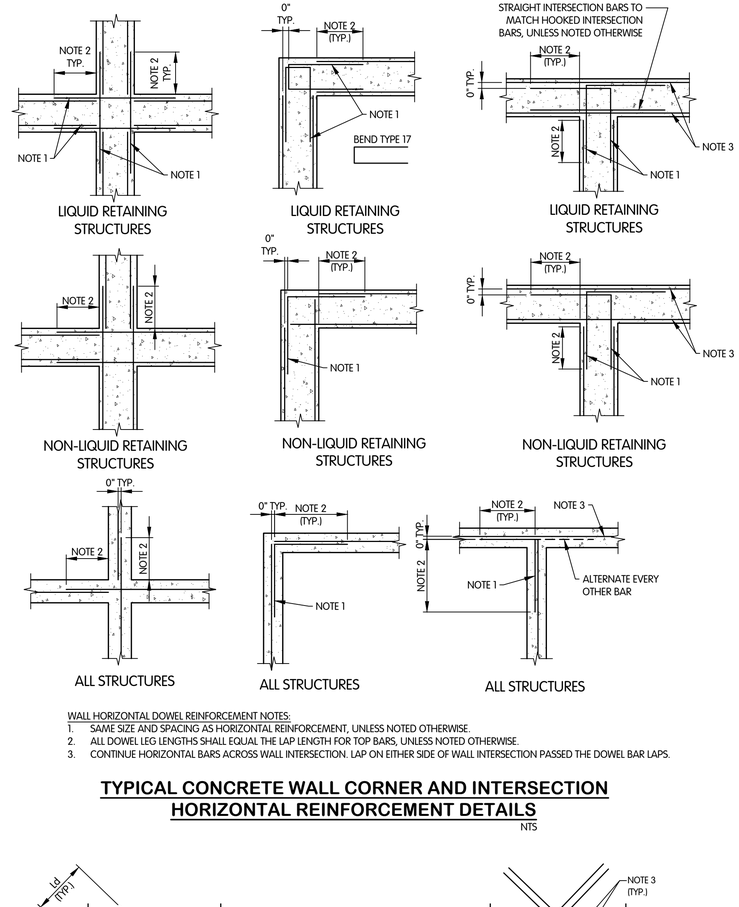
SECTION A

SECTION B

NOTES:
1. PLACE SHEAR ANCHOR BARS SO THAT THE INTERIOR HOOK IS TOUCHING THE COLUMN ANCHORS AS SHOWN BY THE PIER PLAN.
2. THIS SECTION APPLIES TO ALL METAL BUILDING PRIMARY FRAME BUILDING COLUMNS AND WIND COLUMNS

TYPICAL ADDITIONAL PIER REINFORCING DETAIL

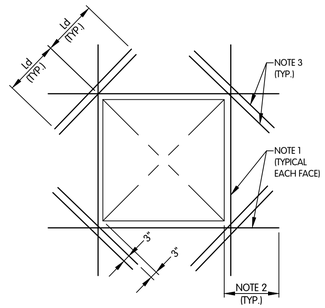
NTS



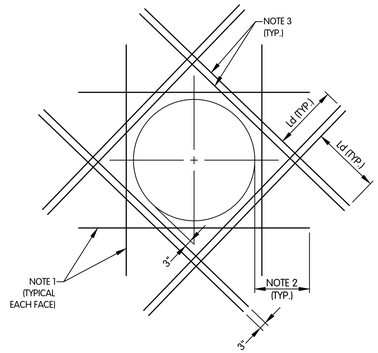
WALL HORIZONTAL DOWEL REINFORCEMENT NOTES:
1. SAME SIZE AND SPACING AS HORIZONTAL REINFORCEMENT, UNLESS NOTED OTHERWISE.
2. ALL DOWEL LEG LENGTHS SHALL EQUAL THE LAP LENGTH FOR TOP BARS, UNLESS NOTED OTHERWISE.
3. CONTINUE HORIZONTAL BARS ACROSS WALL INTERSECTION. LAP ON EITHER SIDE OF WALL INTERSECTION PASSED THE DOWEL BAR LAPS.

TYPICAL CONCRETE WALL CORNER AND INTERSECTION HORIZONTAL REINFORCEMENT DETAILS

NTS



RECTANGULAR



CIRCULAR

REINFORCEMENT AT OPENING NOTES:

1. ADDITIONAL REINFORCEMENT EQUAL IN AREA TO REINFORCEMENT CUT BY OPENING.
2. LAP SPLICE LENGTH FOR TOP BARS.
3. DIAGONAL BARS - EACH FACE, 2 EACH CORNER - SIZE AS FOLLOWS

CONC. THICKNESS	BAR SIZE	DEVELOPMENT LENGTH (Ld)
12" TO 18"	#5	21"
GREATER THAN 18"	#6	25"

4. DIAGONAL BARS NOT REQUIRED FOR OPENINGS WITH LARGEST DIMENSION LESS THAN 12".
5. ONLY DIAGONAL BARS ARE REQUIRED AT DOOR, WINDOW, OR HATCHED OPENING.

TYPICAL ADDITIONAL REINFORCEMENT FOR OPENINGS BETWEEN 8" AND 48"

NTS

THE CITY OF Kalamazoo

CONCRETE REINFORCEMENT DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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1			

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JOB NO. 017-7725.001
SCALE NONE
THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE
DESIGNED KDB | DRAWN CJAF | CHECKED AJD
STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022
SHEET NO. S-6
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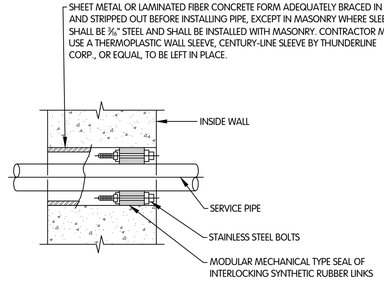
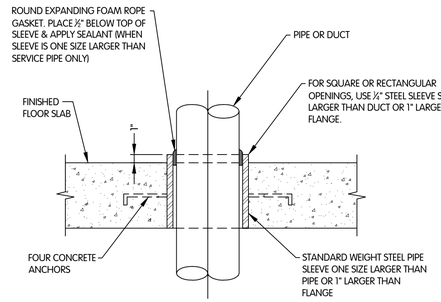
KAL-77250(15)07-CONCRETE REINFORCEMENT DETAILS
11/7/2022 9:54 AM - SWILLIS
11/8/2022 2:31 PM



TYPE C

NOTE:
1. EXISTING WALLS SHALL BE CORE DRILLED.
2. CONCRETE SHALL BE WORKED IN AND VIBRATED TO ELIMINATE ALL VOIDS IN CONCRETE - IF VOIDS DO REMAIN, FILL WITH GROUT BEFORE INSTALLING PIPE AND RUBBER SEALS.
3. UNLESS OTHERWISE SHOWN ON THE DRAWINGS ALL INTERIOR WALL PENETRATIONS SHALL USE TYPE C PIPE SLEEVE.

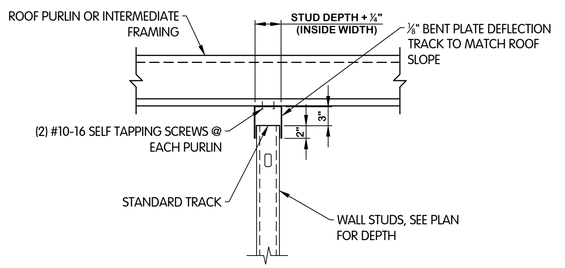
PIPE SLEEVE
NTS



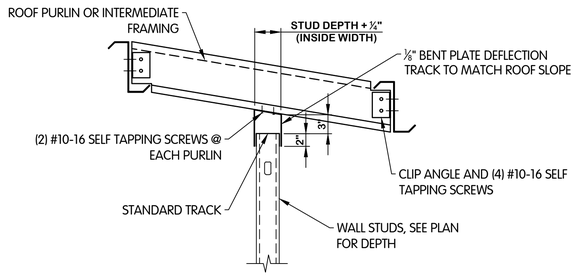
TYPE D

NOTE:
THRU EXISTING FLOORS WHERE TYPE "D" FLOOR SLEEVES ARE CALLED OUT, THE CONTRACTOR SHALL CORE FLOOR AND CAULK AS SHOWN, ELIMINATING THE STEEL SLEEVE.

FLOOR SLEEVE
NTS



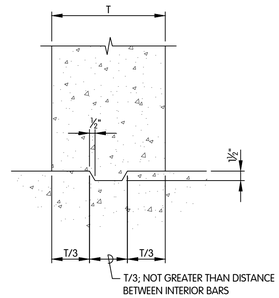
PERPENDICULAR TO PURLINS



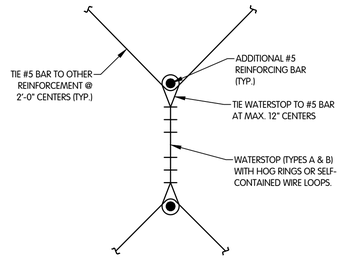
PARALLEL TO PURLINS

NOTES:
1. BUILDING MANUFACTURER SHALL PROVIDE INTERMEDIATE PURLIN FRAMING AT 5'-0" MAX. C/C WHERE WALL RUNS PARALLEL TO ROOF PURLINS.
2. PROVIDE DEFLECTION TRACK ABOVE ALL INTERIOR METAL STUD WALLS.
3. WHERE TRACK RUNS PARALLEL WITH ROOF RIDGE BEND TRACK LEGS AT ROOF PITCH SO THEY REMAIN PLUMB WITH STUD WALLS.

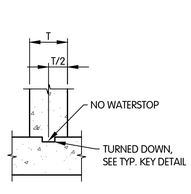
TYPICAL TOP OF INTERIOR STUD WALL CONNECTION DETAIL
NTS



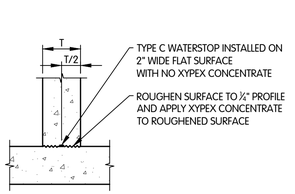
TYPICAL SHEAR KEY



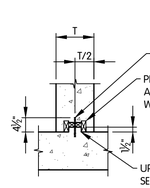
TYPICAL WATERSTOP DETAIL
NTS



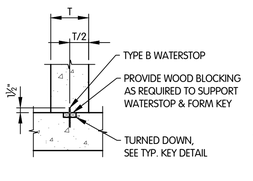
TYPE 4



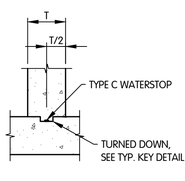
TYPE 5



TYPE 1



TYPE 2



TYPE 3

STANDARD CONSTRUCTION JOINT DETAILS
NTS

THE CITY OF Kalamazoo

WALL CONNECTION AND STRUCTURAL DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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3			
2			
1			

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JOB NO. 017-7725.001

SCALE NONE

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
KDB	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.
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KAL-77250I508-WALL CONNECTION AND STRUCTURAL DETAILS
1/27/2022 10:04 AM S SMILLIS
1/26/2022 2:32 PM
XREFERENCED FILES:

RAILING NOTES:

1. GUARD RAILING SHALL BE STANDARD AND STAIR AND RAMP RAILING SHALL BE TYPE 1, UNLESS NOTED OTHERWISE ON DRAWINGS.
2. MAXIMUM RAILING POST SPACING SHALL BE 5'-0"

WITHOUT STUD	H = 34"	H = 42"
STEEL - SCH. 40	4'-6"	4'-0"
ALUMINUM - SCH. 40	4'-6"	3'-0"
ALUMINUM - SCH. 80	5'-0"	4'-0"

WITH STUD	H = 34"	H = 42"
STEEL - SCH. 40	5'-0"	5'-0"
ALUMINUM - SCH. 40	5'-0"	5'-0"

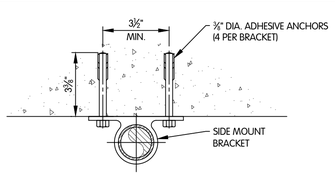
3. REFER TO POST BASE CONNECTION DETAILS FOR ADDITIONAL POST SPACING RESTRAINTS AND STUD INSERT REQUIREMENTS.
4. HANDRAILS ON SWITCHBACK OR DOGLEG STAIRS SHALL BE CONTINUOUS TO ADJACENT FLIGHT.
5. WHEN STAIRS NOTED ON DRAWINGS TO BE ADA ACCESSIBLE, PROVIDE ADDITIONAL 1'-0" EXTENSION AT BOTTOM OF STAIRS.

RAILING BASE CONNECTION NOTES:

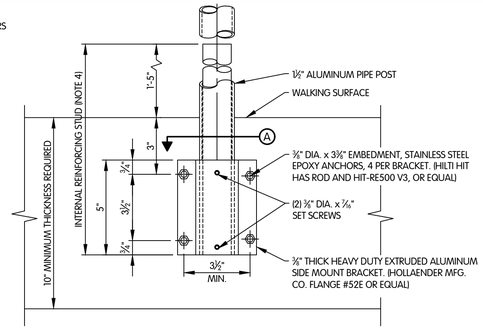
1. PROVIDE COAL TAR PAINT OR NEOPRENE GASKET BETWEEN ALUMINUM SURFACES IN CONTACT WITH CONCRETE, MASONRY, OR DISSIMILAR METALS.
2. ANCHORS FASTENERS:

RAILING MATERIAL	FASTENER
CARBON STEEL	ZINC PLATED CARBON STEEL
ALUMINUM	STAINLESS STEEL
STAINLESS STEEL	STAINLESS STEEL

3. POST BRACKET MATERIAL SHALL MATCH POST MATERIAL, UNLESS NOTED OTHERWISE.
4. POST SHALL BE REINFORCED WITH INTERNAL METAL STUD WHEN REQUIRED BY ENGINEERED DESIGN. STUD SHALL BE WELDED TO POST TO ACT AS ONE MEMBER.



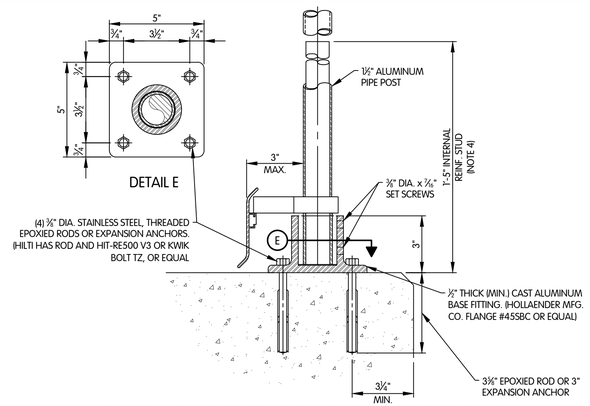
DETAIL A



NOTE:
RAILING POSTS AT CORNERS TO BE LOCATED 6" MIN. FROM CENTER OF POST TO EDGE OF CONCRETE.

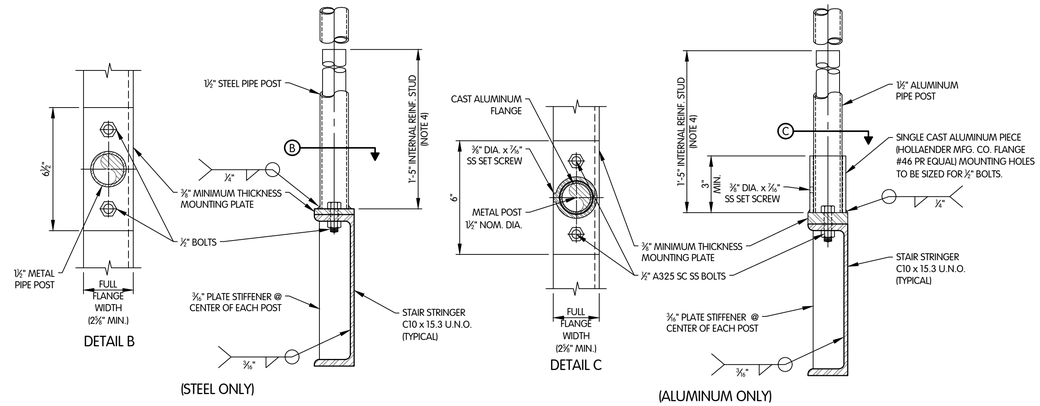
TYPE A ALUMINUM RAILING POST

3" = 1'-0"



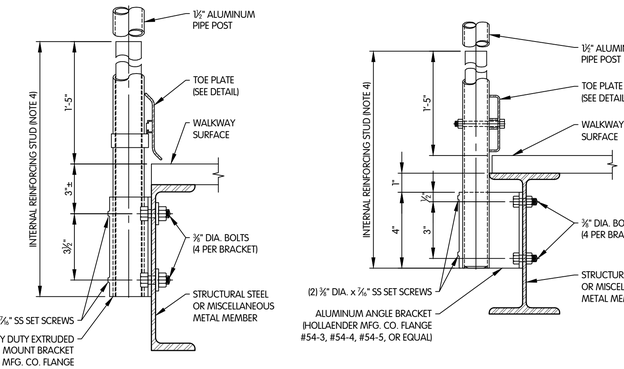
TYPE B ALUMINUM RAILING POST DETAILS

3" = 1'-0"



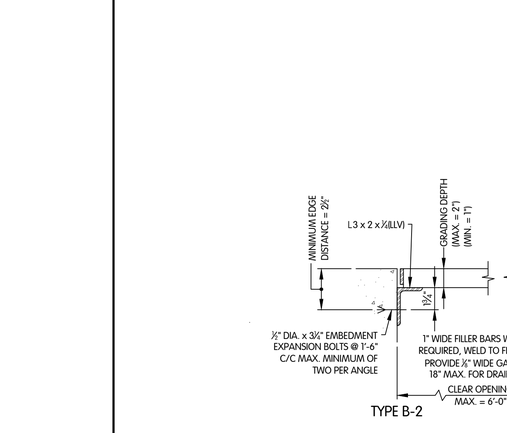
TYPE C METAL STAIR RAILING POST DETAILS

3" = 1'-0"



TYPE D ALUMINUM RAILING POST DETAILS

3" = 1'-0"

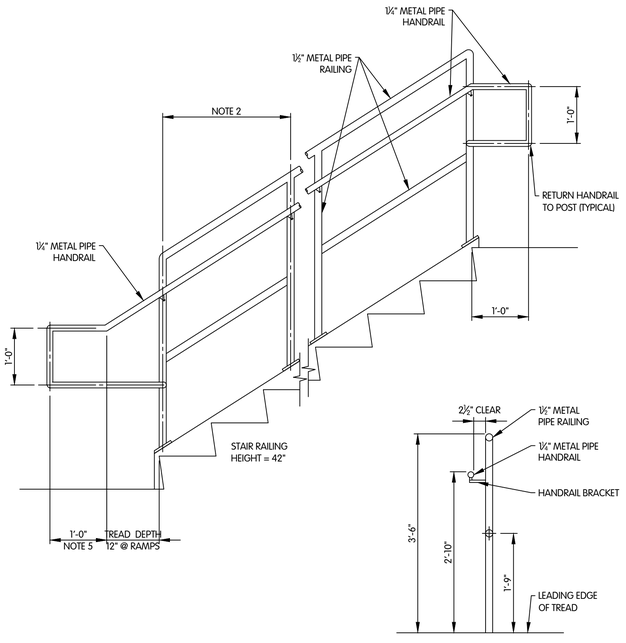


GRATING FRAME DETAILS

2"=1'-0"

GRATING NOTES:

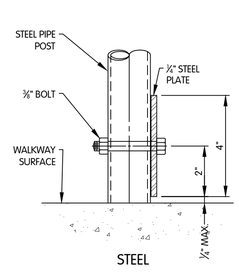
1. APPLY BITUMINOUS PAINT TO ALL ALUMINUM SURFACES IN CONTACT WITH CONCRETE.
2. ANCHORS FOR ALUMINUM AND STAINLESS STEEL TO BE STAINLESS STEEL. ANCHORS FOR GALVANIZED CARBON STEEL TO BE ZINC-PLATED.
3. PROVIDE GALVANIZED STEEL ANGLE FRAMES WITH GALVANIZED STEEL GRATING. FOR ALUMINUM GRATING, PROVIDE ALUMINUM TYPE A FRAME OR STAINLESS STEEL TYPE B-1 OR B-2 FRAMES.
4. FOR B-2 FRAMES USE POWER WRENCH TORQUE REDUCER AS REQUIRED BY ANCHOR MANUFACTURER.



STAIR AND RAMP RAILING, TYPE I

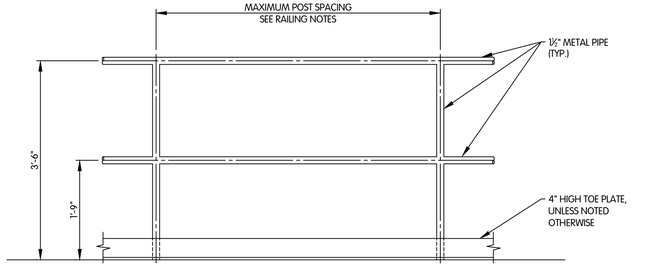
NOTE: STAIR SHOWN, RAMP SIMILAR.

¾" = 1'-0"



TOE PLATE DETAIL

4" = 1'-0"



GUARD RAILING, STANDARD

½" = 1'-0"

KAL-7725001S09
KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN
RAILING AND STRUCTURAL DETAILS
REVISIONS AFTER ISSUED FOR BID
NO. DATE BY
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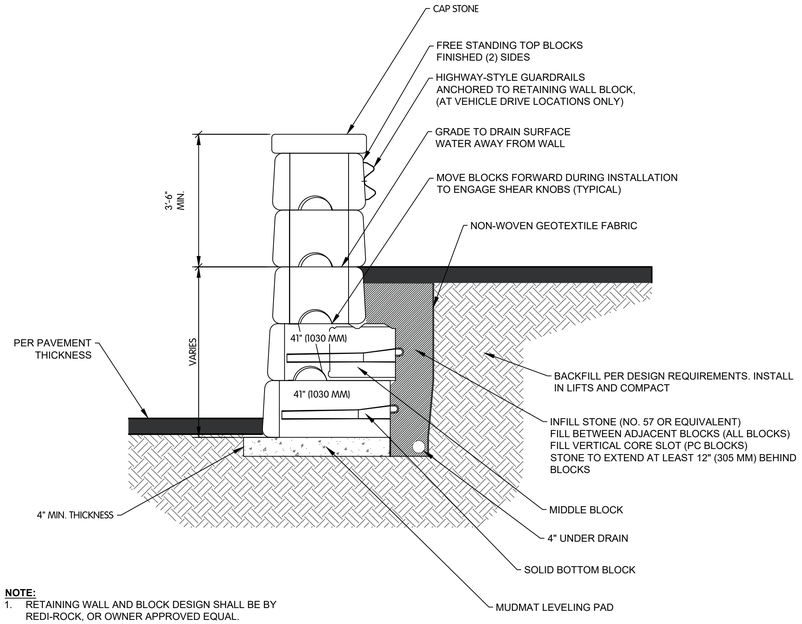
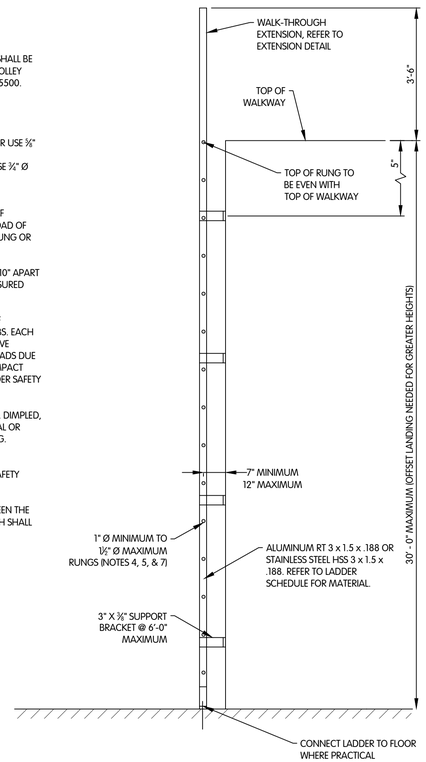
JOB NO. 017-7725.001
SCALE NONE
THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE
DESIGNED KDB DRAWN CJAF CHECKED AJD
STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022
SHEET NO. S-8
21 OF 44
KAL-7725001S09
1/28/2022 2:12 PM



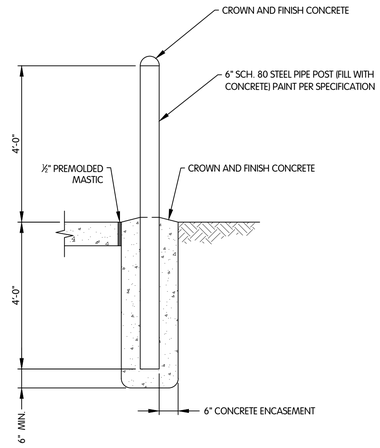
NOTE:
1. RETAINING WALL AND BLOCK DESIGN SHALL BE BY REDI-ROCK, OR OWNER APPROVED EQUAL.
2. BLOCK FINISH AND PROFILE PER OWNER.

TYPICAL RETAINING WALL DETAIL
½" = 1'-0"

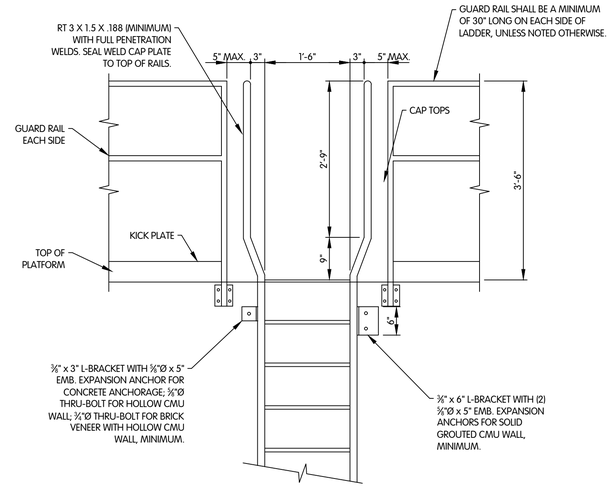
NOTES:
1. ALL CONSTRUCTION TO BE WELDED.
2. LADDERS WITH CLIMB GREATER THAN 24' SHALL BE EQUIPPED WITH FALL PROTECTION RAIL, TROLLEY AND HARNESS. REFER TO SPECIFICATION 05500.
3. SUPPORT BRACKET FASTENER:
   A. TO CONCRETE, USE ⅜" DIAMETER X 5" EMBEDMENT EXPANSION ANCHORS.
   B. MASONRY CMU WALL WITHOUT VENEER USE ½" Ø THRU-BOLT.
   C. MASONRY CMU WALL WITH VENEER USE ¾" Ø THRU-BOLT.
   D. TO STEEL, USE ½" Ø BOLTS.
4. EACH RUNG OR STEP SHALL BE CAPABLE OF SUPPORTING A SINGLE CONCENTRATED LOAD OF 300 LBS. APPLIED IN THE MIDDLE OF THE RUNG OR STEP.
5. RUNGS SHALL BE SPACED NOT LESS THAN 10" APART AND NOT MORE THAN 12" APART AS MEASURED BETWEEN THE CENTERS OF THE RUNGS.
6. EACH FIXED LADDER SHALL BE CAPABLE OF RESISTING AT LEAST TWO LOADS OF 300 LBS. EACH CENTERED BETWEEN ANY TWO CONSECUTIVE ATTACHMENTS PLUS ANY ANTICIPATED LOADS DUE TO ICE BUILD-UP, WINDS, AND RIGGING IMPACT LOADS RESULTING FROM THE USE OF LADDER SAFETY DEVICES (IF APPLICABLE).
7. RUNGS SHALL BE CORRUGATED, KNURLED, DIMPLED, OR COATED WITH SKID RESISTANT MATERIAL OR OTHERWISE TREATED TO MINIMIZE SLIPPING. ADHESIVE GRIT TAPE IS NOT ACCEPTABLE.
8. INTERIOR STEEL LADDERS TO BE PAINTED SAFETY YELLOW.
9. LADDERS RUNGS SHALL BE 18" WIDE BETWEEN THE RAILS. LADDER EXTENSION WALK-THROUGH SHALL BE 24" WIDE BETWEEN THE RAILS.



LADDER SECTION
½" = 1'-0"



BOLLARD DETAIL
NTS



ALUMINUM LADDER TOP EXTENSION DETAIL
¾" = 1'-0"

THE CITY OF Kalamazoo

LADDER AND MISCELLANEOUS DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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SCALE NONE

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KDB	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

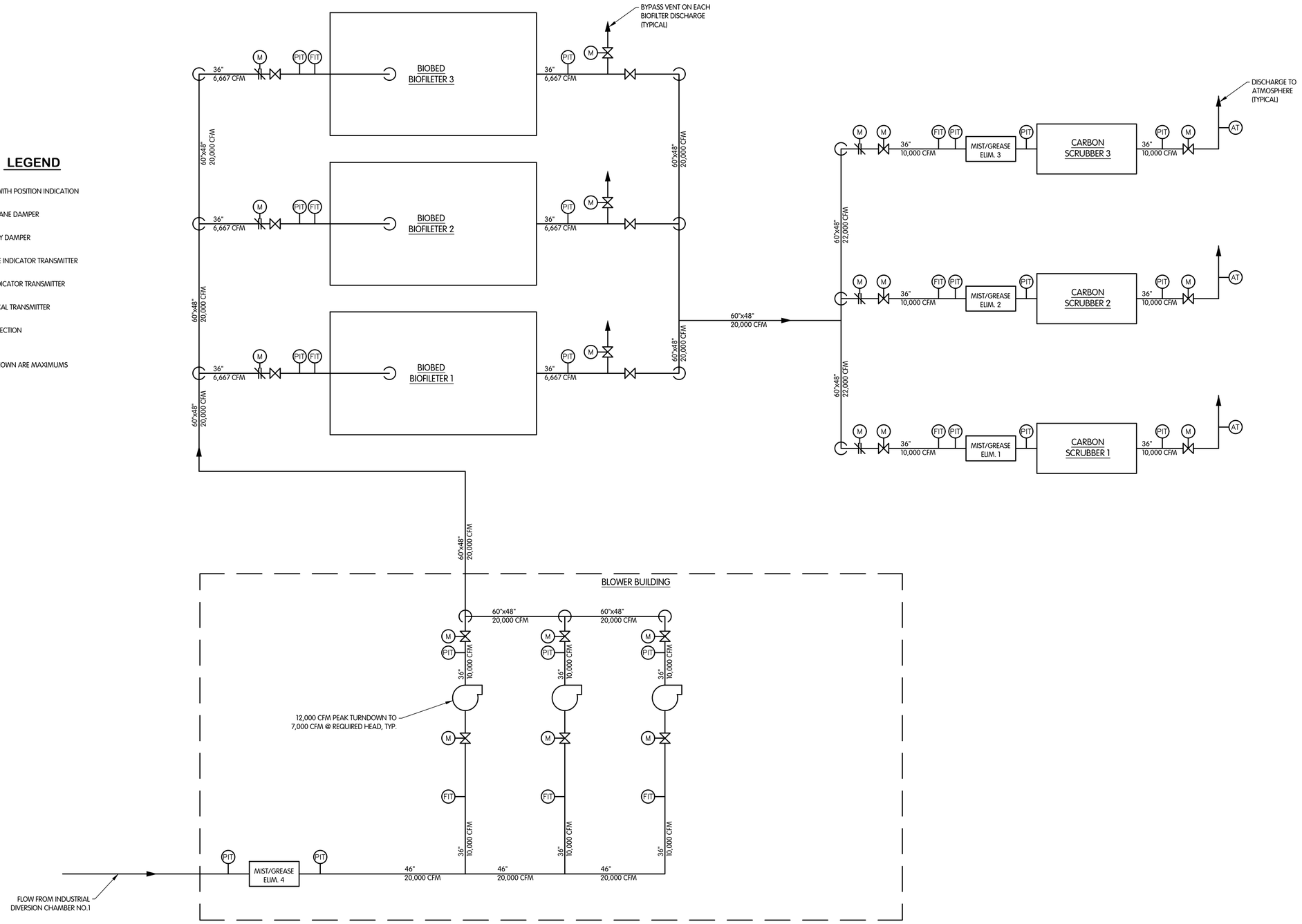
SHEET NO.
S-9

KAL-7725001S10
1/28/2022 2:32 PM
1/28/2022 2:32 PM

LEGEND

- (M) MOTOR WITH POSITION INDICATION
- RADIAL VANE DAMPER
- BUTTERFLY DAMPER
- (PIT) PRESSURE INDICATOR TRANSMITTER
- (FIT) FLOW INDICATOR TRANSMITTER
- (AT) ANALYTICAL TRANSMITTER
- FLOW DIRECTION

FLOW RATES SHOWN ARE MAXIMUMS



BIOFILTRATION AIRFLOW SCHEMATIC

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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SCALE NONE

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DESIGNED	DRAWN	CHECKED
LMM	CJAF	AJD

STATUS: ISSUED FOR BID

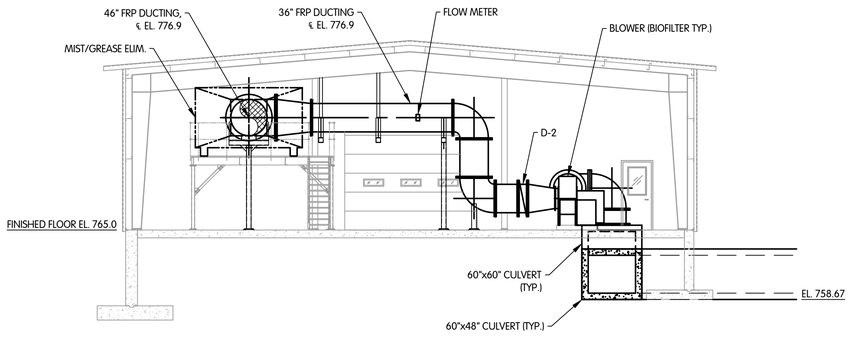
DATE: FEBRUARY 2022

SHEET NO.

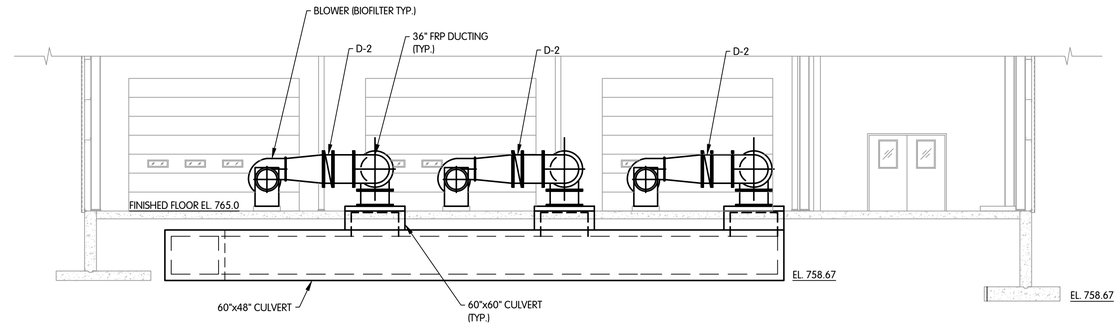
PE-1

23 OF 44

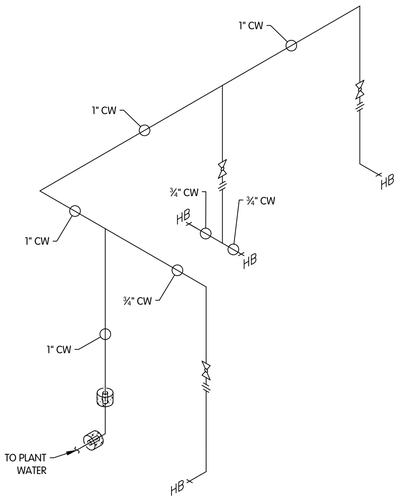
KAL-7725001\03-BIOFILTRATION AIRFLOW SCHEMATIC
1/27/2022 10:44 AM - SWILLIS
1/28/2022 2:32 PM



SECTION B

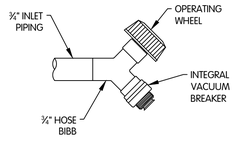


SECTION A

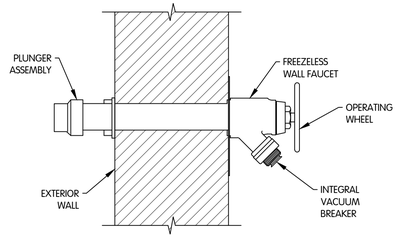


ISOMETRIC
NTS

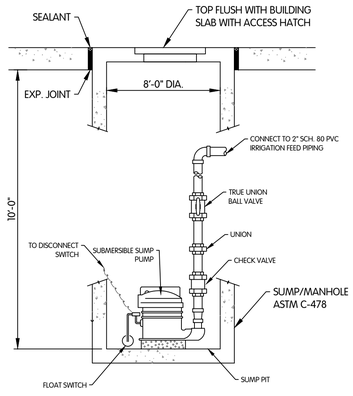
LEGEND
CW = COLD WATER
HB = HOSE BIB



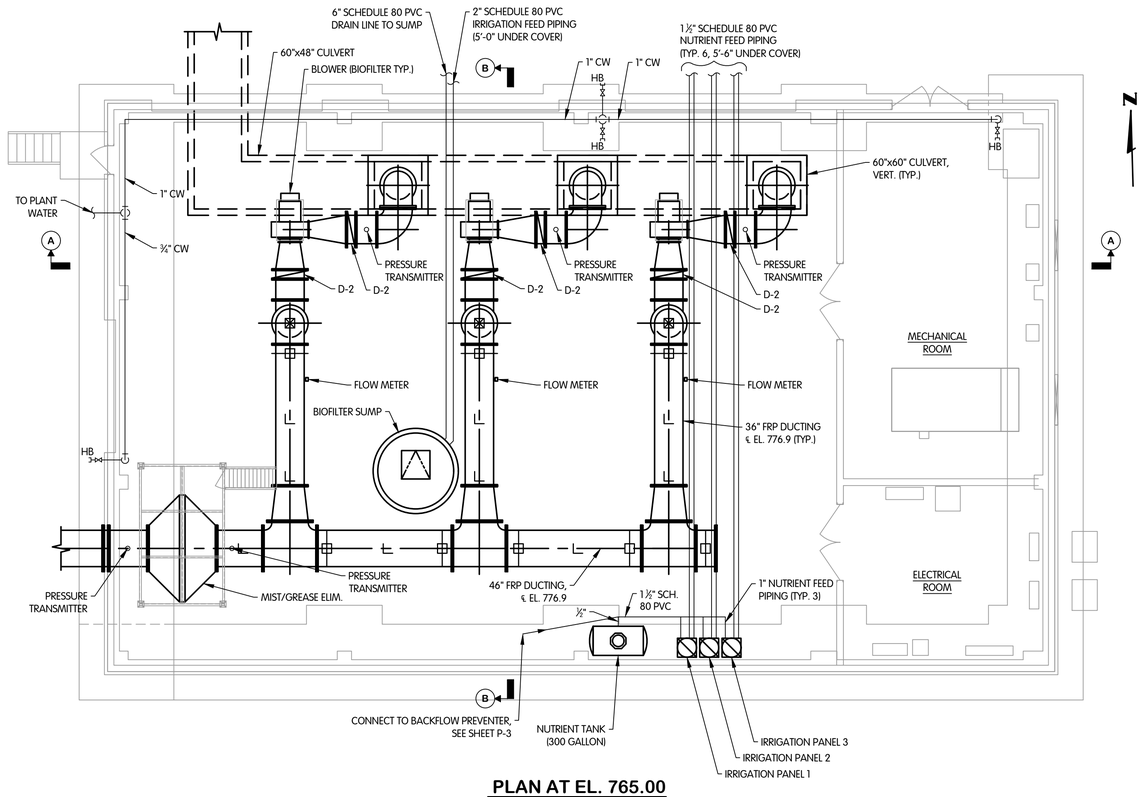
HOSE BIBB DETAIL
NTS



NON-FREEZE WALL FAUCET DETAIL
NTS



SUMP/MANHOLE DETAIL
NTS



PLAN AT EL. 765.00

CONTROL DAMPER SCHEDULE

TAG	SIZE	TYPE	BLADES	MATERIAL	OPERATOR	SERVICE	MAKE	MODEL	NOTES
D-1	36	ISOLATION	BUTTERFLY	FRP	MANUAL	GEAR OPERATOR	RUSKIN	SERIES 914	1, 2, 3
D-2	36	ISOLATION	BUTTERFLY	FRP	MOTORIZED	OPEN/CLOSE	RUSKIN	SERIES 914	1, 2, 4
D-3	36	CONTROL	RADIAL VANE	FRP	MOTORIZED	MODULATING	RUSKIN	SERIES 851FG	1, 2, 4

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. SEE DRAWINGS FOR SIZES, AIRFLOW, AND QUANTITY.
3. PROVIDE WITH LOCKOUT.
4. PROVIDE 120/1/60 DAMPER MOTOR OPERATOR.

THE CITY OF Kalamazoo

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

BLOWER BUILDING
PIPING & EQUIPMENT PLAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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JOB NO. 017-7725.001
SCALE 1/8" = 1'-0"
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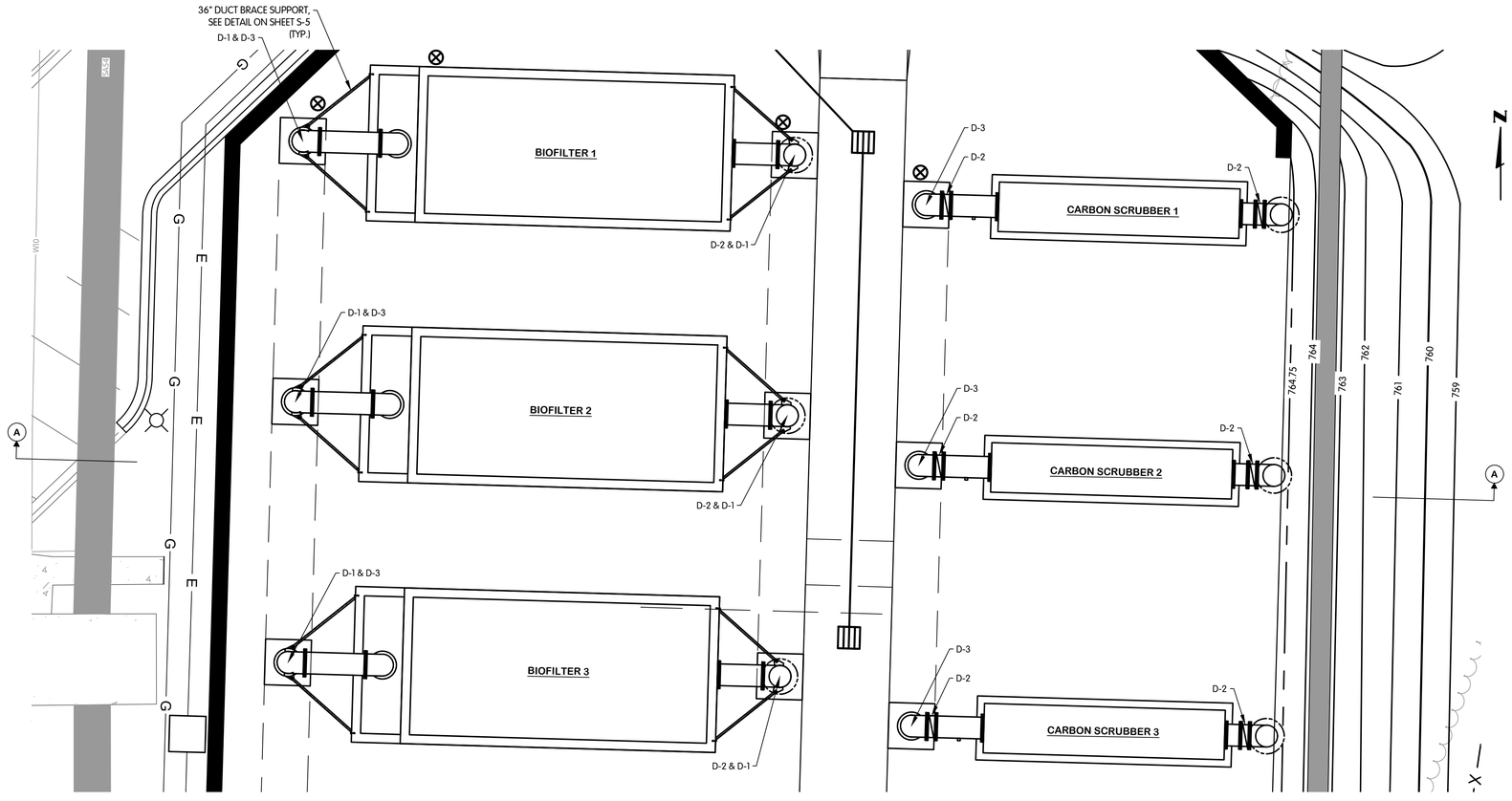
DESIGNED	DRAWN	CHECKED
LMM	CJAF	AJD

STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022

SHEET NO.
PE-2
24 OF 44

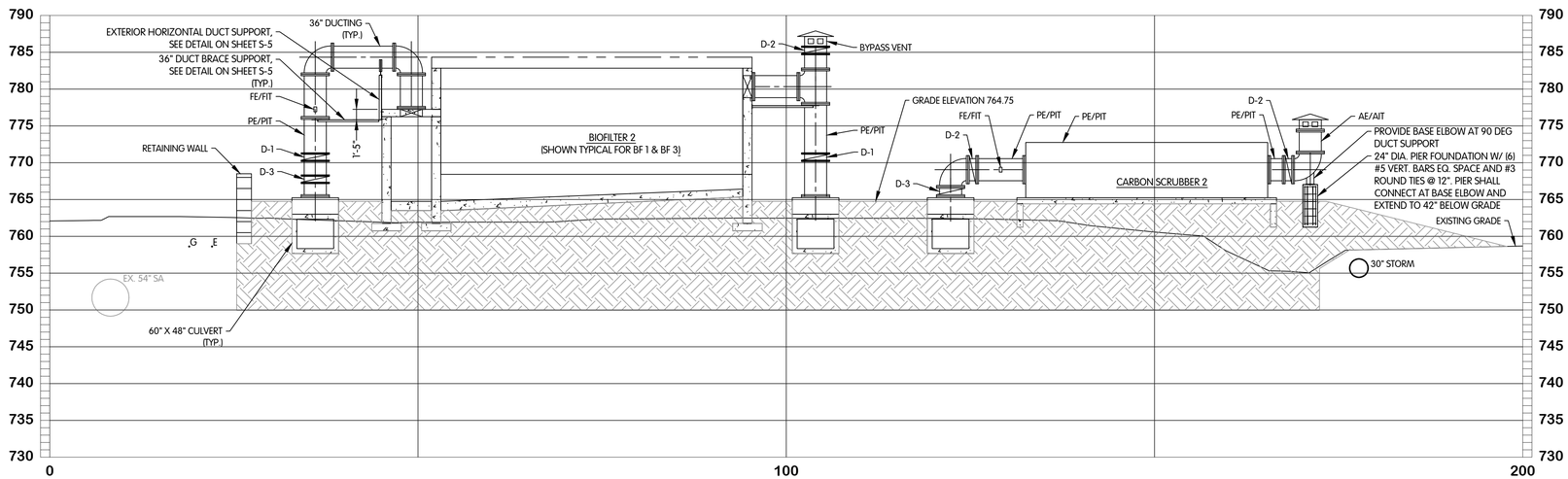
KAL-772500\PED\PE-BLOWER BUILDING PIPING AND EQUIPMENT PLAN
1/28/2022 2:32 PM - SWILLIS



PLAN VIEW

CONTROL DAMPER SCHEDULE									
TAG	SIZE	TYPE	BLADES	MATERIAL	OPERATOR	SERVICE	MAKE	MODEL	NOTES
D-1	36	ISOLATION	BUTTERFLY	FRP	MANUAL	GEAR OPERATOR	RUSKIN	SERIES 914	1, 2, 3
D-2	36	ISOLATION	BUTTERFLY	FRP	MOTORIZED	OPEN/CLOSE	RUSKIN	SERIES 914	1, 2, 4
D-3	36	CONTROL	RADIAL VANE	FRP	MOTORIZED	MODULATING	RUSKIN	SERIES 851FG	1, 2, 4

NOTE:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. SEE DRAWINGS FOR SIZES, AIRFLOW, AND QUANTITY.
3. PROVIDE WITH LOCKOUT.
4. PROVIDE 120/1/60 DAMPER MOTOR OPERATOR.



SECTION A

KAL-772500\PE02-BIOFILTER & CARBON SCRUBBER PIPING & EQUIPMENT SECTION
I:\772500.00 KAL - SWILLIS
1/28/2022 2:32 PM

THE CITY OF Kalamazoo

BIOFILTER & CARBON SCRUBBER PIPING & EQUIPMENT SECTION

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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SCALE 1" = 10'-0"

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DESIGNED	DRAWN	CHECKED
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STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

PE-3

25 OF 44

PLUMBING SYMBOLS LEGEND

- METER ASSEMBLY
- RPZ BACKFLOW PREVENTER
- FLEXIBLE PIPE CONNECTOR
- FLEXIBLE PIPE
- CHECK VALVE
- GATE VALVE
- BALL VALVE (MANUAL)
- PLUG VALVE
- BUTTERFLY VALVE
- COMBINATION BALANCING VALVE
- THERMOSTATIC MIXING VALVE
- PRESSURE REDUCING VALVE, SELF CONTAINED
- SOLENOID OPERATED VALVE
- TEMPERATURE/PRESSURE RELIEF VALVE
- DRAIN
- STRAINER
- STRAINER WITH BLOW OFF VALVE AND PLUG
- UNION CONNECTION
- FLANGED CONNECTION
- SPOOL PIECE, FLANGED
- HOSE CONNECTOR
- AIR VENT
- EXPANSION JOINT OR COMPENSATOR
- PIPE ANCHOR
- PIPE GUIDE
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER-FLUSH TOP
- ECCENTRIC REDUCER-FLUSH BOTTOM
- PIPE ELBOW, 90 TURNED DOWN
- PIPE ELBOW, 90 TURNED UP
- PIPE TEE, OUTLET TURNED DOWN
- PIPE TEE, OUTLET TURNED UP
- EXPANSION LOOP
- CAP ON END OF PIPE
- CLEANOUT PLUG
- PRESSURE GAGE WITH SHUT-OFF COCK (BALL VALVE)
- PRESSURE SWITCH
- FLOW SWITCH
- THERMOMETER
- CENTRIFUGAL PUMP
- WATER HAMMER ARRESTOR
- VENT PIPING
- FLOOR CLEANOUT
- FLOOR OR ROOF DRAIN
- VENT THROUGH ROOF
- P-TRAP

PLUMBING ABBREVIATIONS

AD	AREA DRAIN
AFF	ABOVE FINISHED FLOOR
BFP	BACKFLOW PREVENTER
CA	COMPRESSED AIR
CFH	CUBIC FEET PER HOUR
CL	CENTERLINE
CS	CUP SINK
CW	COLD WATER
DF	DRINKING FOUNTAIN
DIA	DIAMETER
DN	DOWN (PENETRATES FLOOR SLAB)
ELEV	ELEVATION
EESU	EMERGENCY EYEWASH AND SHOWER UNIT
EEW	EMERGENCY EYEWASH
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FT	FEET
GAL	GALLONS
GCO	GRADE CLEANOUT
GPM	GALLONS PER MINUTE
GWH	GAS FIRED WATER HEATER
HB	HOSE BIBB
HC	HOSE CONNECTION
HR	HOSE REEL
HW	HOT WATER
HWR	HOT WATER RETURN
HWRP	HOT WATER RECIRCULATION PUMP
IW	INDIRECT WASTE
IN	INCH
KS	KITCHEN SINK
LAV	LAVATORY
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MS	MOP SINK
NG	NATURAL GAS
NPW	NON POTABLE WATER
NTS	NOT TO SCALE
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH (GAUGE)
PW	POTABLE WATER
RD	ROOF DRAIN
SAN	SANITARY
SD	STORM DRAIN
SH	SHOWER
SP	SUMP PUMP
SQFT	SQUARE FEET
SS	SERVICE SINK
TMV	THERMOSTATIC MIXING VALVE
TW	TEPID WATER
TWH	TANKLESS WATER HEATER
TYP	TYPICAL
UP	UP (PENETRATES FLOOR SLAB)
UR	URINAL
V	VENT
VAC	VACUUM
VB	VACUUM BREAKER
VTR	VENT THROUGH ROOF
W	WASTE
WC	WATER CLOSET
WCO	WALL CLEANOUT
WF	WALL FAUCET
WHA	WATER HAMMER ARRESTOR
W/	WITH

PLUMBING GENERAL NOTES

1. THE SYMBOLS AND ABBREVIATIONS LIST ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. THEREFORE, NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED IN THIS LIST ARE NECESSARILY USED ON THIS PARTICULAR PROJECT AND SHOULD BE USED FOR CLARIFICATION ONLY.
2. ALL WORK SHALL BE CARRIED OUT AS PER THE LATEST REQUIREMENTS OF BUILDING, PLUMBING, AND ELECTRICAL CODES, AMERICANS WITH DISABILITIES ACT (ADA), AND ALL OTHER GOVERNING AGENCIES HAVING JURISDICTION.
3. PROVIDE ALL MATERIAL, EQUIPMENT, AND PERFORM ALL LABOR REQUIRED TO INSTALL COMPLETE AND OPERABLE PLUMBING SYSTEMS AS INDICATED ON THE DRAWINGS, AS SPECIFIED, AND AS REQUIRED BY CODE.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD AND SHALL REPORT DISCREPANCIES, IF ANY, TO THE ENGINEER FOR CLARIFICATION PRIOR TO STARTING ANY WORK.
5. COORDINATE ACTUAL LOCATIONS AND SIZES OF ALL EQUIPMENT CONNECTONS, DRAINS, ETC., WITH EQUIPMENT DIMENSIONAL DRAWINGS. REFER TO ARCHITECTURAL DRAWINGS FOR ACTUAL LOCATIONS OF ALL PLUMBING FIXTURES, MINOR ADJUSTMENTS TO CONDITIONS SHALL BE SUPPLIED AT NO ADDITIONAL COST TO THE OWNER.
6. INSTALL ALL PLUMBING EQUIPMENT AND APPURTENANCES IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, CONTRACT DOCUMENTS, AND APPLICABLE CODES AND REGULATIONS.
7. THE CONTRACTOR SHALL PERFORM ALL CUTTING, CORE DRILLING, CHIPPING, AND PATCHWORK AS REQUIRED.
8. ALL SURFACES DAMAGED IN THE COURSE OF THE WORK SHALL BE RESTORED TO THE ORIGINAL CONDITION AND IN ACCORDANCE TO DRAWINGS AND SPECIFICATIONS. LOCATIONS AND SIZES OF ALL FLOOR, WALL, AND ROOF OPENINGS SHALL BE COORDINATED WITH THE OTHER TRADES.
9. ALL FLOOR DRAINS ARE AT LOW POINTS OF FLOORS AND SHALL BE INSTALLED FLUSH WITH THE FINISHED FLOOR. LOCATIONS ARE SHOWN ON THE STRUCTURAL DRAWINGS.
10. ALL FLOOR DRAINS FOR EQUIPMENT SHALL BE FIELD COORDINATED AND LOCATED ADJACENT TO THE EQUIPMENT PADS IN THE APPROXIMATE LOCATIONS SHOWN ON THE DRAWINGS.
11. ALL BRANCH PIPING TO EQUIPMENT OR FIXTURES SHALL BE PROVIDED WITH SHUT-OFF VALVES, WHETHER SHOWN, OR NOT SHOWN ON DRAWINGS.
12. CHANGES IN DIRECTION IN DRAINAGE PIPING SHALL BE MADE BY THE USE OF 45 DEGREE ELLS, LONG SWEEPS, 90 DEGREES WYES WITH CLEANOUTS, OR BY A COMBINATION OF EQUIVALENT FITTINGS. THERE SHALL BE NO DOUBLE WYES IN THE HORIZONTAL PLANE.
13. SANITARY TEES AND QUARTER BENDS MAY BE USED IN DRAINAGE LINES ONLY WHERE DIRECTION OF FLOW IS FROM HORIZONTAL TO THE VERTICAL.
14. ALL VENT RISERS RUN STRAIGHT THROUGH ROOF SHALL HAVE AN APPROVED EXPANSION JOINT SYSTEM INSTALLED BELOW ROOF.
15. ALL PIPING CONNECTIONS TO EQUIPMENT SHALL BE THROUGH UNION CONNECTIONS. PROVIDE DI-ELECTRIC UNIONS OR FLANGES TO ISOLATE DISSIMILAR METALS.
16. ALL WYE TYPE STRAINERS SHALL HAVE A 3-INCH LONG THREADED NIPPLE, THREADED END BALL VALVE AND CAP OR PLUG ON BLOWDOWN SIDE.
17. AN ACCESSIBLE CLEANOUT SHALL BE PROVIDED AT THE BASE OF EACH SOIL OR WASTE STACK AND ROOF LEADER.
18. ALL DRAINAGE PIPING SHALL BE INSTALLED TO SLOPE AT A MINIMUM 1/8" PER FOOT UNLESS OTHERWISE NOTED.
19. ALL PIPING PENETRATING OR IN CONTACT WITH CONCRETE, MASONRY, OR OTHER CORROSIVE MATERIAL SHALL BE SLEEVED.
20. ALL HOT AND TEPID WATER PIPING AND ALL COLD WATER PIPING ABOVE SUSPENDED CEILINGS SHALL BE INSULATED.
21. ALL EXPOSED FIXTURE P-TRAPS, FITTINGS, AND VALVES SHALL BE CHROME PLATED COPPER OR BRASS.
22. P-TRAPS SHALL BE PROVIDED AT ALL FLOOR DRAINS EXCEPT WHERE NOTED.
23. VENT PIPING SERVING FLOOR DRAIN HEADERS SHALL BE TAKEN OFF ABOVE THE CENTERLINE OF THE SOIL PIPE, AND THE VENT SHALL RISE AT AN ANGLE NOT MORE THAN 45 DEGREES.
24. WHERE TWO OR MORE ITEMS OF THE SAME TYPE OF EQUIPMENT ARE REQUIRED, THE PRODUCT OF ONE MANUFACTURER SHALL BE USED.
25. COORDINATE THE EXACT ROUTING OF PIPES WITH OTHER TRADE CONTRACTORS SO THAT NO CONFLICTS OCCUR WITH PIPING, LIGHTS, STRUCTURE, DUCTS, ETC.
26. ESCUTCHEONS AND COVER PLATES ARE REQUIRED FOR FINISH WALL PENETRATIONS.
27. ALL VENT PIPING SHALL SLOPE UP TO THE VENT THROUGH THE ROOF. VENT THROUGH THE ROOF TERMINATION SHALL BE A MINIMUM OF 10'-0" FROM ANY FRESH AIR INTAKES.
28. AUTOMATIC TRAP PRIMERS SHALL BE USED FOR FLOOR DRAINS. THE PRIMER SHALL BE THE PASSIVE TYPE FED-OFF OF THE NEAREST COLD WATER PIPE SERVING A FREQUENTLY USED FIXTURE.
29. NATURAL GAS PIPING CONNECTION TO EQUIPMENT OR APPLIANCE SHALL BE PROVIDED WITH A FULL SIZED DIRT LEG AND UNION.
30. NATURAL GAS PRESSURE REGULATORS LOCATED OUTDOORS SHALL HAVE THERE VENTS TURNED DOWN AND SCREENED.
31. NATURAL GAS PRESSURE REGULATORS LOCATED INDOORS SHALL HAVE INDIVIDUAL FULL SIZED VENT PIPING TO THE EXTERIOR.

THE CITY OF Kalamazoo

PLUMBING LEGEND & GENERAL NOTES

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
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1	REVISIONS AFTER ISSUED FOR BID	

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JOB NO. 017-7725.001

SCALE NONE

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LMM	CJAF	AJD

STATUS: ISSUED FOR BID

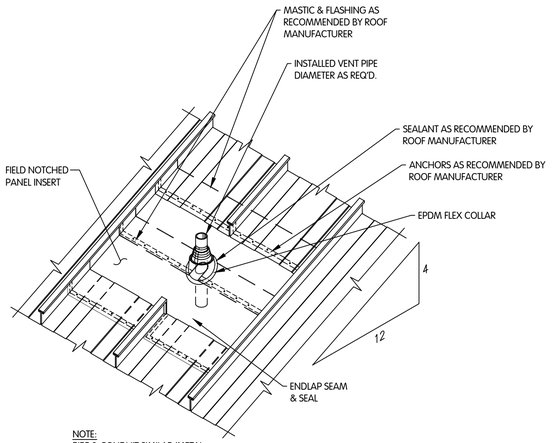
DATE: FEBRUARY 2022

SHEET NO.

P-1

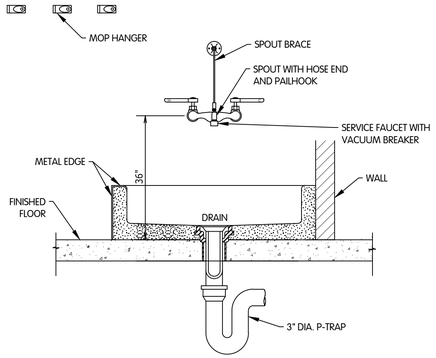
26 OF 44

KAL-77250(P0)-PLUMBING LEGEND & GENERAL NOTES
ACAD 2020 9.00 AM - SWILLIS
1/28/2022 2:32 PM



NOTE:
PIPE & CONDUIT SIMILAR (METAL SLEEVE NOT REQUIRED)

ROOF VENT PIPE DETAIL
NTS



MOP SINK DETAIL
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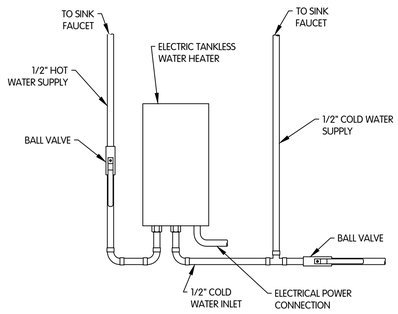

ELECTRIC TANKLESS WATER HEATER DETAIL
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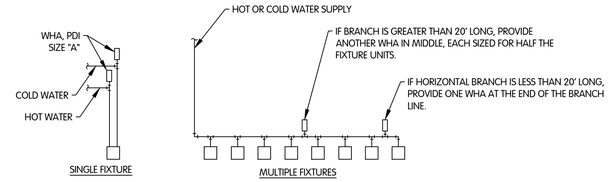
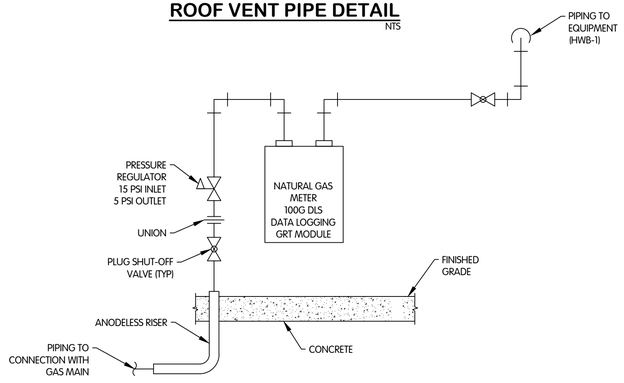


WATER HAMMER ARRESTER SIZE		
P.D.I. SIZE	PIPE SIZE (IN.)	FIXTURE UNITS (FU)
AA	1/2	1-3
A	1/2	1-11
B	3/4	12-32
C	1	33-60
D	1-1/4	61-113
E	1-1/2	114-154
F	2	155-330

FIXTURE UNIT TABULATION		
FIXTURE	COLD	HOT
WATER CLOSET FLUSH VALVE	10	---
WATER CLOSET FLUSH TANK	5	---
URINAL FLUSH VALVE	5	---
SHOWER HEAD	3	3
SERVICE SINK/MOP SINK	2.25	2.25
LAVATORY	1.5	1.5
KITCHEN SINK	1	1
HOSE BIBB/WALL FAUCET	3	---
DRINKING FOUNTAIN	0.25	---

NOTE:
DO NOT PROVIDE AIR CHAMBERS. PROVIDE WATER HAMMER ARRESTERS BY PRECISION PLUMBING PRODUCTS, SIOUX CHIEF, WATTS, OR EQUAL, WITH PISTON AND O-RING CONSTRUCTION HAVING PDI #WH-201, ASSE #1010, AND ANSI #A112.26.1M CERTIFICATION. INSTALL IN HORIZONTAL OR VERTICAL POSITION, NEVER IN THE UPSIDE DOWN POSITION. INSTALL IN LINE WITH WATER FLOW DIRECTION IF POSSIBLE. SIZE THE UNITS AS SHOWN ON THE DRAWINGS AND/OR PER TABLES SHOWN ABOVE. INSTALL PER PDI STANDARDS AND MANUFACTURER'S INSTRUCTIONS.

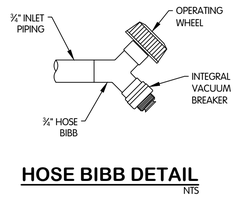
WATER HAMMER ARRESTER DETAIL
NTS



NOTES:

1. NATURAL GAS METER AND PRESSURE REGULATOR SET ASSEMBLY TO BE FURNISHED AND INSTALLED BY CONTRACTOR.
2. NATURAL GAS METER AND PRESSURE REGULATOR SET ASSEMBLY SHALL BE PROTECTED PER THE REQUIREMENTS OF NATURAL GAS PROVIDER.
3. ALL BURIED NATURAL GAS PIPING SHALL BE PE 4710 HDPE IPS SDR-11. ALL ABOVE GRADE OR EXPOSED PIPING SHALL BE SCHEDULE 40 BLACK STEEL.
4. INSTALL BOLLARDS AROUND NATURAL GAS METER AND PIPING FOR PROTECTION. SEE BOLLARD DETAIL.

NATURAL GAS METER AND PRESSURE REGULATOR SET ASSEMBLY DETAIL
NTS



HOSE BIBB DETAIL
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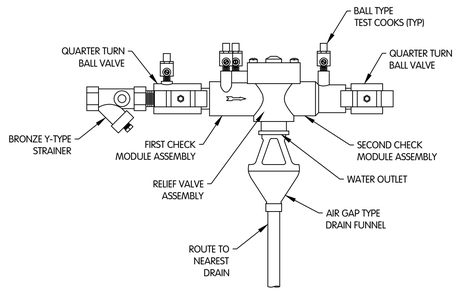

SMALL BACKFLOW PREVENTER DETAIL
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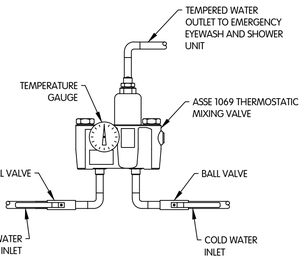

THERMOSTATIC MIXING VALVE DETAIL
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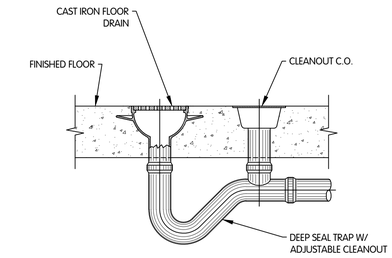

TYPE B FLOOR DRAIN DETAIL
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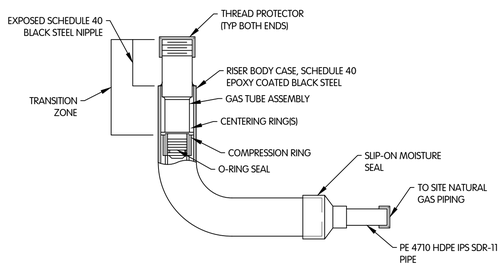

NATURAL GAS PIPE RISER DETAIL
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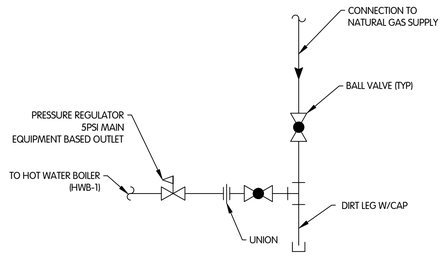
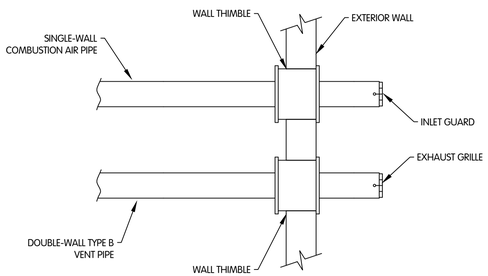


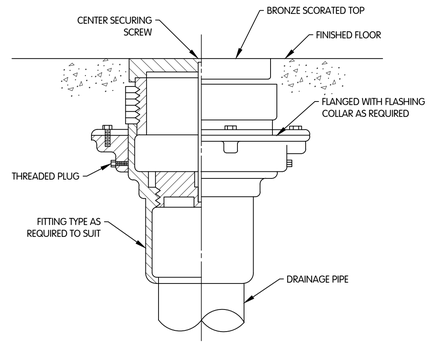
GAS PIPING EQUIPMENT CONNECTION DETAIL
NTS



NOTES:

1. INSTALLATION OF COMBUSTION AIR PIPES AND FLUE GAS PIPES TO BE IN ACCORDANCE WITH ASSOCIATED MANUFACTURER'S RECOMMENDATIONS.

COMBUSTION AIR AND FLUE GAS DETAIL
NTS



FLOOR CLEANOUT DETAIL
NTS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

PLUMBING DETAILS

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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SCALE NONE
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STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022
SHEET NO. P-2
27 OF 44

KAL-77250IP04-PLUMBING DETAILS
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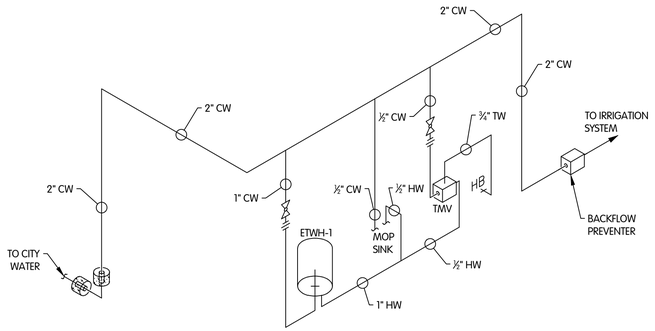
1/28/2022 2:32 PM

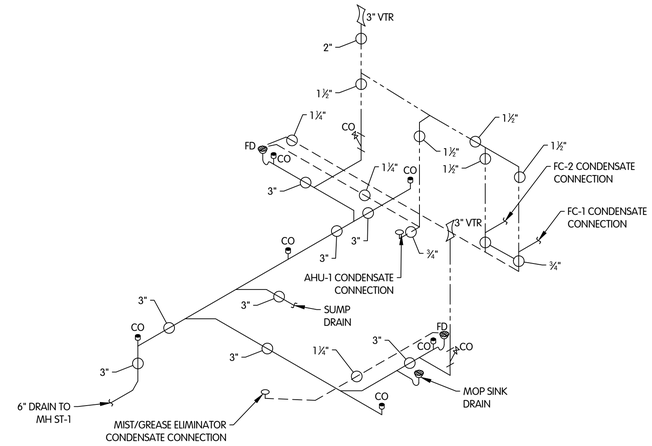


PLUMBING ISOMETRIC

NTS

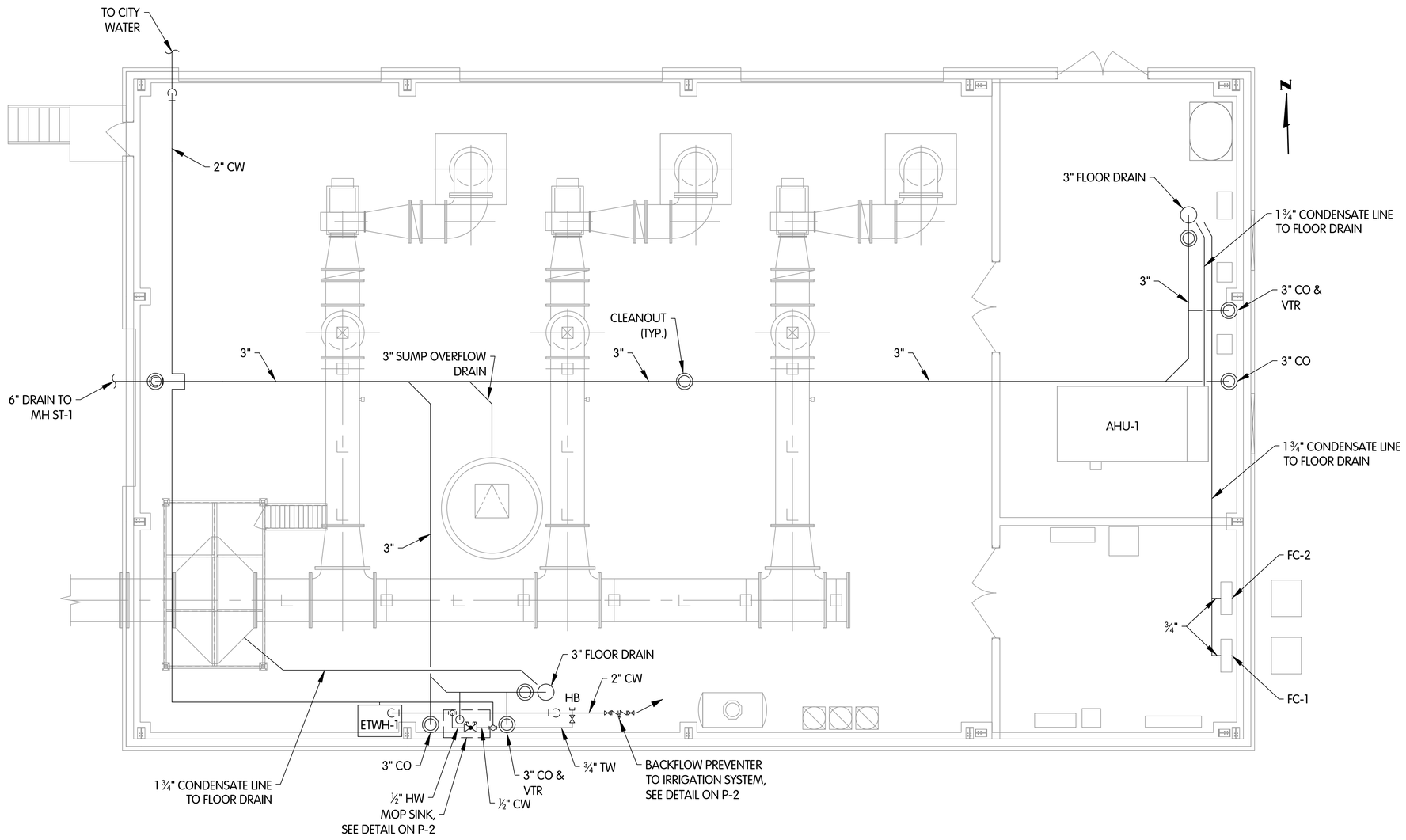
LEGEND

ETWH = ELECTRIC TANKLESS WATER HEATER
TMV = TEMPERATURE METERING VALVE
VTR = VENT THROUGH ROOF
HB = HOSE BIB
CW = COLD WATER
HW = HOT WATER
TW = TEMPERED WATER



DRAIN ISOMETRIC

NTS



THE CITY OF Kalamazoo

BLOWER BUILDING
PLUMBING LAYOUT

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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JOB NO. 017-7725.001

SCALE 3/16" = 1'-0"

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LMM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

P-3

28 OF 44

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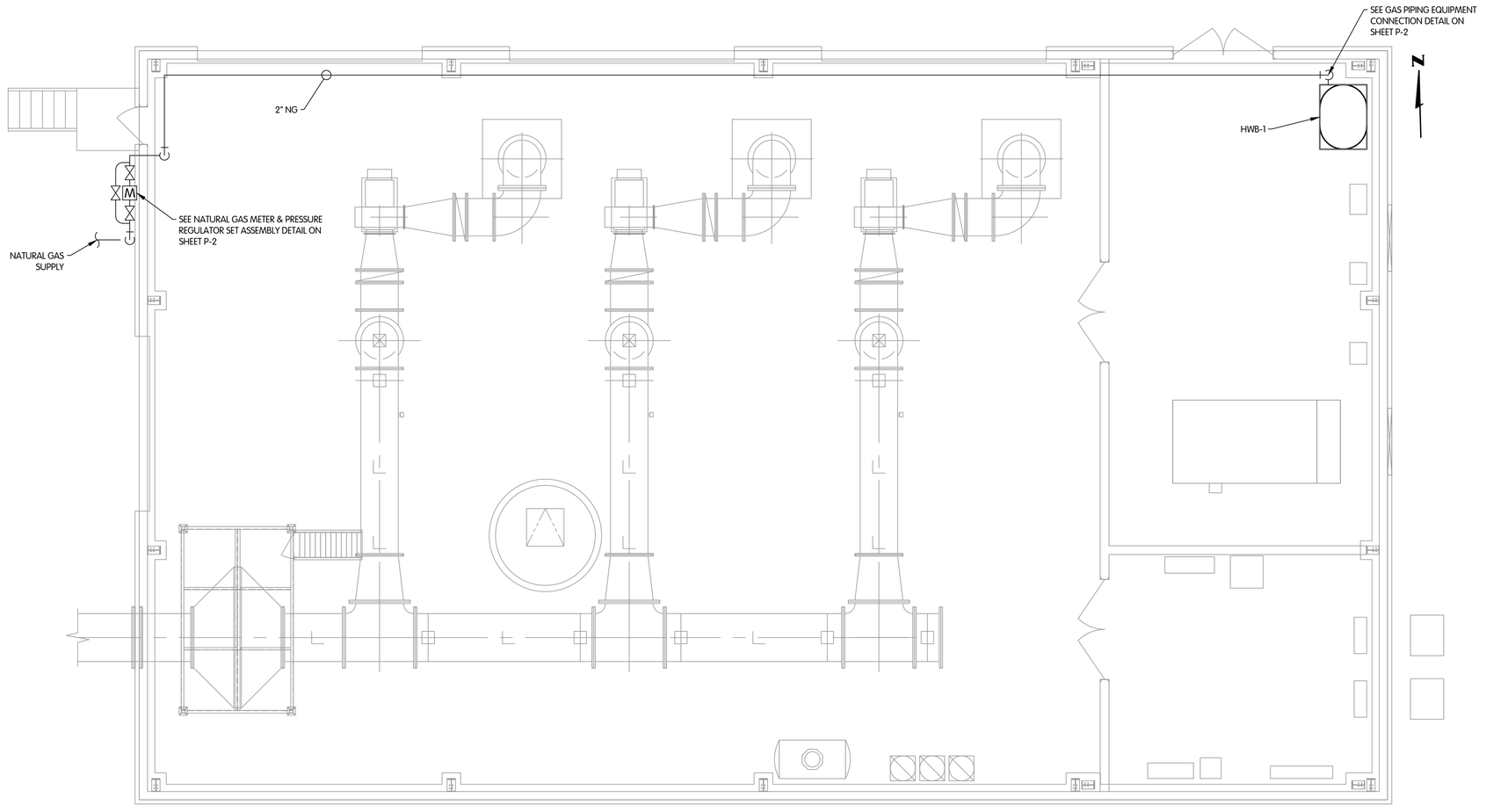
1/28/2022 2:12 PM



THE CITY OF Kalamazoo

BLOWER BUILDING NATURAL GAS LAYOUT

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
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JOB NO. 017-7725.001

SCALE 3/16" = 1'-0"

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LMM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

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K:\KAL-77250\PI\35-BLOWER BUILDING NATURAL GAS LAYOUT
1/28/2022 2:53 PM - SWILLIS

HVAC SYMBOLS LEGEND

- METER ASSEMBLY
- RPZ BACKFLOW PREVENTER
- FLEXIBLE PIPE CONNECTOR
- FLEXIBLE PIPE
- CHECK VALVE
- GATE VALVE
- GLOBE VALVE (MANUAL) N.C.
- BALL VALVE (MANUAL)
- PLUG VALVE
- BUTTERFLY VALVE
- COMBINATION BALANCING VALVE
- COMBINATION PUMP DISCHARGE VALVE
- ANGLE GATE VALVE (MANUAL)
- AUTOMATIC CONTROL VALVE 2-WAY
- AUTOMATIC CONTROL VALVE 3-WAY
- PRESSURE REDUCING VALVE, SELF CONTAINED
- PRESSURE REDUCING VALVE, PILOT OPERATED
- SOLENOID OPERATED VALVE
- MOTORIZED BALL VALVE
- PRESSURE RELIEF VALVE
- DRAIN
- STRAINER
- STRAINER WITH BLOW OFF VALVE AND PLUG
- UNION CONNECTION
- FLANGED CONNECTION
- SPOOL PIECE, FLANGED
- HOSE CONNECTOR
- AIR VENT
- EXPANSION JOINT OR COMPENSATOR
- PIPE ANCHOR
- PIPE GUIDE
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER-FLUSH TOP
- ECCENTRIC REDUCER-FLUSH BOTTOM
- PIPE ELBOW, 90 TURNED DOWN
- PIPE ELBOW, 90 TURNED UP
- PIPE TEE, OUTLET TURNED DOWN
- PIPE TEE, OUTLET TURNED UP
- EXPANSION LOOP
- PRESSURE GAGE WITH SHUT-OFF COCK (BALL VALVE)
- PRESSURE SWITCH
- FLOW SWITCH
- THERMOMETER
- CENTRIFUGAL PUMP
- THERMOSTAT
- CONTROL SWITCH
- PUMP SUCTION DIFFUSER

- SUPPLY AIRFLOW
- RETURN OR EXHAUST AIRFLOW
- DIRECTION OF FLOW IN DUCTWORK
- 12x8 DUCT SIZE-FIRST FIGURE IS SIDE SHOWN
- DUCT SECTION, SUPPLY
- DUCT SECTION, RETURN
- DUCT SECTION, EXHAUST
- MOTORIZED DAMPER
- SMOKE DAMPER WITH ACCESS DOOR
- FIRE DAMPER WITH ACCESS DOOR
- MANUAL BALANCING DAMPER
- BACKDRAFT DAMPER
- CHANGE OF ELEVATION: RISE (R) OR DROP (D)
- ACCESS DOOR OR ACCESS PANEL
- MITERED ELBOW WITH TURNING VANES
- FLEXIBLE DUCT CONNECTION
- SPLITTER DAMPER-SEE PLAN FOR NECK SIZE
- AIR EXTRCATOR WITH VANES
- DUCT TRANSITION RECTANGULAR
- DUCT TRANSITION RECTANGULAR TO ROUND
- BRANCH TAKE-OFF FROM MAIN DUCT
- VANED ELBOW 90 (SHORT RADIUS)
ROUND ELBOW 90 (SHORT RADIUS)
- DUCT ELBOW 90-TURNED UP-RECTANGULAR
- DUCT ELBOW 90-TURNED DOWN-RECTANGULAR
- SUPPLY REGISTER
- RETURN GRILLE
- EXHAUST GRILLE
- SUPPLY DIFFUSER-ROUND NECK
- VAV BOX, TERMINAL UNIT
- (#,SIZE)
(CFM) TERMINAL AIR DEVICE NOMENCLATURE
- FLEXIBLE DUCTWORK
- MOTOR ACTUATED DAMPER
- OPPOSED BLADE DAMPER
- PARALLEL BLADE DAMPER
- SMOKE DETECTOR (P-PHOTOELECTRIC, I-IONIZATION)
- CENTRIFUGAL FAN
- PROPELLER FAN
- VANEAXIAL FAN
- UNIT HEATER

HVAC ABBREVIATIONS

AC	AIR CONDITIONING
ACU	AIR CONDITIONING UNIT
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
AMB	AMBIENT
AMP	AMPERAGE
APD	AIR PRESSURE DROP
B	BOILER
BD	BALANCING DAMPER
BDD	BACKDRAFT DAMPER
BFP	BACKFLOW PREVENTER
BHP	BRAKE HORSEPOWER
BOD	BOTTOM OF DUCT
BTU	BRITISH THERMAL UNIT
BTUH	BRITISH THERMAL UNIT PER HOUR
CW	CLOCKWISE
CCW	COUNTER CLOCKWISE
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CU	CONDENSING UNIT
CUH	CABINET UNIT HEATER
CV	CONTROL VALVE
CWCP	CHILLED WATER CIRCULATION PUMP
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
DB	DRY BULB
DIA	DIAMETER
EA	EXHAUST AIR
EAT	ENTERING AIR TEMPERATURE
EF	EXHAUST FAN
EFF	EFFICIENCY
EG	EXHAUST GRILLE
ELEV	ELEVATION
ESP	EXTERNAL STATIC PRESSURE
EUH	ELECTRIC UNIT HEATER
EWH	ELECTRIC WALL HEATER
EWT	ENTERING WATER TEMPERATURE
FA	FREE AREA
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FF	FINISHED FLOOR
FPM	FEET PER MINUTE
FRP	FIBERGLASS REINFORCED PLASTIC
FT	FEET
GAL	GALLONS
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GUH	GAS FIRED UNIT HEATER
H	HEATING
HP	HORSEPOWER
HR	HOUR
HVU	HEATING VENTILATING UNIT
HVAC	HEATING, VENTILATING, AND AIR CONDITIONING
HWCP	HOT WATER CIRCULATION PUMP
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWUH	HOT WATER UNIT HEATER
HZ	HERTZ
IN	INCHES
IN. WG	INCHES WATER GAGE
KW	KILOWATTS
KWH	KILOWATTS PER HOUR
L	LOUVER
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LF	LINEAR FEET
LWT	LEAVING WATER TEMPERATURE
MAU	MAKE-UP AIR UNIT
MIN	MINUTE
MD	MOTORIZED DAMPER
MFG	MANUFACTURER
N/A	NOT APPLICABLE
NC	NORMALLY CLOSED
NG	NATURAL GAS
NO	NORMALLY OPEN
OA	OUTSIDE AIR
PD	PRESSURE DROP
PH	PHASE
PS	PRESSURE SWITCH
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAGE
RA	RETURN AIR
RG	RETURN GRILLE
RH	RELATIVE HUMIDITY
RL	REFRIGERANT LIQUID
RPM	REVOLUTIONS PER MINUTE
RS	REFRIGERANT SUCTION
SA	SUPPLY AIR
SD	SUPPLY DIFFUSER, SUPPLY DETECTOR, SMOKE DAMPER
SF	SUPPLY FAN
SP	STATIC PRESSURE
SR	SUPPLY REGISTER
SV	SOLENOID VALVE
T	THERMOSTAT
TSP	TOTAL STATIC PRESSURE
TYP	TYPICAL
V	VENTILATING, VOLTS
VAV	VARIABLE AIR VOLUME
W	WATT
W/	WITH
WB	WET BULB
WC	WATER COLUMN
WPD	WATER PRESSURE DROP

HVAC GENERAL NOTES

1. THE SYMBOLS AND ABBREVIATIONS LIST ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. THEREFORE, NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED IN THIS LIST ARE NECESSARILY USED ON THIS PARTICULAR PROJECT AND SHOULD BE USED FOR CLARIFICATION ONLY.
2. ALL WORK SHALL BE CARRIED OUT AS PER THE LATEST REQUIREMENTS OF BUILDING, MECHANICAL, PLUMBING, AND ELECTRICAL CODES, NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), AMERICANS WITH DISABILITIES ACT (ADA), AND ALL OTHER GOVERNING AGENCIES HAVING JURISDICTION.
3. PROVIDE ALL MATERIAL, EQUIPMENT, AND PERFORM ALL LABOR REQUIRED TO INSTALL COMPLETE AND OPERABLE HVAC SYSTEMS AS INDICATED ON THE DRAWINGS, AS SPECIFIED, AND AS REQUIRED BY CODE.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD AND SHALL REPORT DISCREPANCIES, IF ANY, TO THE ENGINEER FOR CLARIFICATION PRIOR TO STARTING ANY WORK.
5. EXACT LOCATION OF ALL EQUIPMENT AND ACCESSORIES SHALL BE VERIFIED IN THE FIELD. EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE. ACTUAL DIMENSIONS TO BE DETERMINED BY EQUIPMENT FURNISHED.
6. INSTALL ALL HVAC EQUIPMENT AND APPURTENANCES IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, CONTRACT DOCUMENTS, AND APPLICABLE CODES AND REGULATIONS.
7. THE CONTRACTOR SHALL PERFORM ALL CUTTING, CORE DRILLING, CHIPPING, AND PATCHWORK AS REQUIRED.
8. ALL SURFACES DAMAGED IN THE COURSE OF THE WORK SHALL BE RESTORED TO THE ORIGINAL CONDITION AND IN ACCORDANCE TO DRAWINGS AND SPECIFICATIONS. LOCATIONS AND SIZES OF ALL FLOOR, WALL, AND ROOF OPENINGS SHALL BE COORDINATED WITH THE OTHER TRADES.
9. ALL OPENINGS IN FIRE WALLS DUE TO DUCTWORK, PIPING, CONDUITS, ETC., SHALL BE FIRE STOPPED WITH A PRODUCT SIMILAR TO 3M OR EQUAL.
10. ALL MATERIALS SHALL BE AS PER THE DRAWINGS AND SPECIFICATIONS AND SHALL BE APPROVED BY THE ENGINEER PRIOR TO ITS INSTALLATION.
11. ALL WORK SHALL BE COORDINATED WITH OTHER TRADES DURING INSTALLATION.
12. ALL INDICATED DUCT DIMENSIONS ARE CLEAR INSIDE DIMENSIONS. CONTRACTOR SHALL INCORPORATE THICKNESS OF DUCT INSULATION OR LINING AS APPLICABLE TO DETERMINE TOTAL OUTSIDE DIMENSIONS. FIRST DIMENSION IS IN PLANE OF DRAWING, SECOND IS PERPENDICULAR TO DRAWING.
13. PROVIDE FLEXIBLE DUCT CONNECTIONS AT THE POINT OF CONNECTION IN SUPPLY, RETURN, AND EXHAUST DUCTWORK SYSTEMS BETWEEN THE HVAC EQUIPMENT AND DUCTWORK.
14. PROVIDE ALL 90 DEGREE SQUARE ELBOWS WITH SINGLE THICKNESS TURNING VANES UNLESS OTHERWISE INDICATED. PROVIDE ACESS DOORS UPSTREAM OF ALL ELBOWS WITH TURNING VANES.
15. PROVIDE BALANCING DAMPERS AT POINTS ON SUPPLY, RETURN, AND EXHAUST SYSTEMS WHERE BRANCHES ARE TAKEN FROM LARGER DUCTS AS REQUIRED FOR BALANCING. INSTALL MINIMUM TWO DUCT WIDTHS FROM DUCT TAKE-OFF. PROVIDE BALANCING DAMPERS ON DUCT TAKE-OFF TO DIFFUSERS, REGISTERS, AND GRILLES, REGARDLESS OF WHETHER DAMPERS ARE SPECIFIED AS PART OF THE DIFFUSER, REGISTER, OR GRILLE ASSEMBLY. ALL BALANCING DAMPERS SHALL BE PROVIDED WITH LOCKING POSITION INDICATORS.
16. PROVIDE ACCESS DOORS IN DUCTWORK AT SMOKE DETECTORS, FIRE DAMPERS, SMOKE DAMPERS, AND BALANCING DAMPERS, AND OTHER ITEMS LOCATED IN THE DUCTWORK WHICH REQUIRE SERVICE AND/OR INSPECTION.
17. EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE. ACTUAL DIMENSIONS TO BE DETERMINED BY EQUIPMENT FURNISHED.
18. CONCRETE HOUSEKEEPING PADS TO SUIT HVAC EQUIPMENT SHALL BE SIZED AND LOCATED BY THE HVAC CONTRACTOR. PADS SHALL BE FURNISHED AND INSTALLED BY THE GENERAL CONTRACTOR. COORDINATE FINAL EQUIPMENT SIZE AND LOCATION OF HOUSEKEEPING PADS WITH THE GENERAL CONTRACTOR. MINIMUM CONCRETE PAD THICKNESS SHALL BE 6 INCHES. PAD SHALL EXTEND BEYOND THE EQUIPMENT A MINIMUM OF 6 INCHES ON EACH SIDE.
19. COORDINATE ALL EQUIPMENT CONNECTIONS WITH MANUFACTURERS' CERTIFIED DRAWINGS. COORDINATE AND PROVIDE ALL DUCT AND PIPING TRANSITIONS REQUIRED FOR FINAL EQUIPMENT CONNECTIONS FURNISHED EQUIPMENT. FIELD VERIFY AND COORDINATE ALL DUCT AND PIPING DIMENSIONS BEFORE FABRICATION.
20. PROVIDE VIBRATION ISOLATION FOR ALL HVAC EQUIPMENT TO PREVENT TRANSMISSION OF VIBRATION TO BUILDING STRUCTURE.
21. INSTALL UNIONS AND/OR FLANGES BETWEEN HVAC EQUIPMENT AND PIPING TO PERMIT DISASSEMBLY FOR ALTERATION OR REPAIRS.
22. PROVIDE FLEXIBLE CONNECTIONS IN ALL PIPING SYSTEMS CONNECTED TO PUMPS OR HVAC EQUIPMENT AND OTHER EQUIPMENT WHICH REQUIRES VIBRATION ISOLATION EXCEPT AT COILS. FLEXIBLE CONNECTIONS SHALL BE INSTALLED AS CLOSE TO THE HVAC EQUIPMENT AS POSSIBLE OR AS INDICATED ON THE DRAWINGS.
23. LOCATE ALL TEMPERATURE, PRESSURE, AND FLOW MEASURING DEVICES IN ACCESSIBLE LOCATIONS WITH STRAIGHT SECTION OF PIPE OR DUCT UP AND DOWNSTREAM AS RECOMMENDED BY THE MANUFACTURER FOR GOOD ACCURACY.
24. WHERE TWO OR MORE ITEMS OF THE SAME TYPE OF EQUIPMENT ARE REQUIRED, THE PRODUCT OF ONE MANUFACTURER SHALL BE USED.
25. FOR LOUVER LOCATIONS, SEE ARCHITECTURAL DRAWINGS.
26. ALL AIR CONDITIONING AND CONDENSING TYPE HEATING EQUIPMENT CONDENSATE DRAIN PIPING FROM EQUIPMENT SHALL BE PIPED FULL SIZE OF THE UNIT DRAIN OUTLET WITH "P" TRAP AND PIPED AND DISCHARGED TO THE NEAREST DRAIN SLOPED 1/8 INCH PER FOOT. SEE HVAC DETAILS FOR DEPTH OF CONDENSATE TRAP.
27. ALL PIPING AND DUCTS IN FINISHED ROOMS SHALL BE CONCEALED IN FURRED CHASES OR SUSPENDED CEILINGS. ACCESS DOORS SHALL BE INSTALLED FOR ANY CONCEALED DEVICE REQUIRING ADJUSTMENT.
28. FOR INTERLOCKING WIRING SCHEMATICS SEE ELECTRICAL DRAWINGS.
29. ALL CONTROL WIRING AND CONDUIT SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE AND DIVISION 16 OF THE SPECIFICATIONS.
30. THERMOSTATS AND OTHER CONTROL COMPONENTS SHALL BE MOUNTED 5'-0" A.F.F. UNLESS OTHERWISE NOTED.
31. ALL TESTS SHALL BE COMPLETED BEFORE ANY HVAC EQUIPMENT OR PIPING INSULATION IS APPLIED.

THE CITY OF Kalamazoo

HVAC LEGEND & GENERALNOTES

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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DESIGNED	DRAWN	CHECKED
LMM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.
H-1
30 OF 44

KAL-77250\IH02-HVAC LEGEND & GENERAL NOTES
1/27/2022 10:01 AM - SWILLIS
1/26/2022 1:32 PM

HOT WATER UNIT HEATER SCHEDULE

TAG	LOCATION	TYPE	TOTAL (MBH)	AIRFLOW (CFM)	WATER DATA				ELECTRICAL			MAKE	MODEL	NOTES
					FLOW (GPM)	EWT (°F)	LWT (°F)	PD (FT)	FAN	MOTOR	V/PH/HZ			
HWUH-1	MECHANICAL ROOM	PROPELLER	8	245	0.8	200	180	0.8	16 W	1550	120/1/60	TRANE	UHSBA08	1,2
HWUH-2	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-3	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-4	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-5	ELECTRICAL ROOM	PROPELLER	8.0	245.0	0.8	200.0	180.0	0.8	16 W	1550.0	120/1/60	TRANE	UHSBA08	1,2
HWUH-6	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-7	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-8	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2
HWUH-9	PROCESS AREA	PROPELLER	24.8	580.0	2.5	200.0	180.0	2.2	25 W	1550.0	120/1/60	TRANE	UHSBA25	1,2

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. UNIT SHALL BE ASME CERTIFIED.

HOT WATER PUMP SCHEDULE

TAG	LOCATION	TYPE	SERVICE	WATER DATA			ELECTRICAL			MAKE	MODEL	NOTES
				FLOW (GPM)	HEAD (FT)	PUMP EFFICIENCY (%)	MOTOR (HP)	MOTOR (RPM)	V/PH/HZ			
HWP-1	MECHANICAL ROOM	IN-LINE	HOT WATER	142.5	26	72.0	2	1750	480/3/60	BELL & GOSSETT	E-80 3x3x7C	1,2
HWP-2	MECHANICAL ROOM	IN-LINE	HOT WATER	142.5	26	72.0	2	1750	480/3/60	BELL & GOSSETT	E-80 3x3x7C	1,2

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. INSTALL WITH FLEXIBLE PIPE CONNECTIONS.

DUCTLESS SPLIT MINI SCHEDULE

TAG	LOCATION	TYPE	REFRIGERANT	CAPACITIES		FC				NOTES
				COOLING (BTUH)	HEATING (BUTH)	MAKE	MODEL	V/PH/HZ	MCA	
FC-1/CU-1	ELECTRIC ROOM	DUCTLESS MINISPLIT	R410A	12,000	N/A	TRANE	4MXW2312	208/1/60	3	1,2,3,4,5,6,7,8,9
FC-2/CU-2	ELECTRIC ROOM	DUCTLESS MINISPLIT	R410A	12,000	N/A	TRANE	4MXW2312	208/1/60	3	1,2,3,4,5,6,7,8,9

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. INDOOR FC ELECTRICALLY POWERED FROM OUTDOOR UNIT HP.
3. INDOOR FC WITH FOUR FAN SPEEDS.
4. INDOOR FC WITH FILTER TRACK AND FACTORY SUPPLIED CLEANABLE FILTER.
5. HP WITH ROTARY TYPE COMPRESSOR.
6. EVAPORATOR COIL ENTERING AIR DRY BULB/WET BULB TEMPERATURES: 80/67 DEGREES F.
7. CONDENSING UNIT AMBIENT AIR DRY BULB TEMPERATURE: 95 DEGREES F.
8. PRE-CHARGED LINE SETS FOR INSTALLATION OF REFRIGERANT PIPING.
9. HARD WIRED REMOTE CONTROLLER WITH MODE, FAN SPEED, AND TEMPERATURE SELECTION, CARRIER MODEL KSACN0101AAA.

FAN SCHEDULE

TAG	LOCATION	MAKE	MODEL	AIRFLOW (CFM)	STATIC PRESSURE (INCH W.C.)	DRIVE	POWER (HP)	ELECTRICAL (V/PH/HZ)	NOTES
EF-1	MECHANICAL ROOM	LOREN COOK	Vane Axial Fan 36CVB	11,300	0.50	BELT	3	480/3/60	1,2,3,4,5,6,7,8,9,10,11

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. INTEGRAL PRE-WIRED, NEMA 3R RATED DISCONNECT SWITCH.
3. SPARKPROOF ALUMINUM CONSTRUCTION.
4. GRAVITY TYPE BACKDRAFT DAMPER.
5. INLET AND OUTLET FLEXIBLE DUCT CONNECTIONS.
6. VIBRATION ISOLATORS.
7. BELT GUARD.
8. WEATHERPROOF MOTOR AND BELT GUARD COVER.
9. SPARE BELT SET.
10. ALUMINUM BIRDSCREEN.
11. FINISH PROVEN CORROSION RESISTANT WITH HYDROGEN SULFIDE FUMES.

HOT WATER BOILER SCHEDULE

TAG	LOCATION	TYPE	FUEL	INPUT (BTUH)	OUTPUT (BTUH)	WATER DATA				ELECTRICAL		MAKE	MODEL	NOTES
						FLOW (GPM)	EWT (°F)	LWT (°F)	PD (FT)	MOTOR (HP)	V/PH/HZ			
HWB-1	MECHANICAL ROOM	CONDENSING BOILER	NATURAL GAS	1,750,000	1,684,000	142	180	200	5	1/2	120/1/60	LOCHINVAR	FBN1751	1,2,3

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. PROVIDE ASME RATED PRESSURE RELIEF VALVE.
3. PROVIDE WITH MODULATING BURNER CONTROL.

GLYCOL FEED SCHEDULE

TAG	LOCATION	TYPE	SERVICE	WATER DATA		PRESSURE SWITCH DATA			ELECTRICAL			TANK DATA	MAKE	MODEL	NOTES
				FLOW (GPM)	HEAD	Cut-In Pressure (PSI)	Cut-Out Pressure (PSI)	Adjustable Pressure Differential (PSI)	FAN MOTOR (HP)	MOTOR (RPM)	V/PH/HZ	VOLUME (GAL)			
GF-1	MECHANICAL ROOM	AUTOMATIC W/ POLYETHYLENE TANK	HOT WATER	1.5	100	10-45	20-60	10-30	1/3	1750	120/1/60	50	Neptune	G-50-1	1,2

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. INSTALL WITH FLEXIBLE PIPE CONNECTIONS.

AIR HANDLING UNIT SCHEDULE

TAG	LOCATION	TYPE	SUPPLY AIRFLOW (CFM)	OUTSIDE AIRFLOW (CFM)	FAN SECTION			HEATING COIL DATA							COOLING COIL DATA	FILTER		ELECTRICAL (V/PH/HZ)	MAKE	MODEL	NOTES
					E.S.P. (IN. W.C.)	HP	FAN TYPE	TOTAL (MBH)	FLOW (GPM)	EAT (°F)	LAT (°F)	EWT (°F)	LWT (°F)	WPD (FT)	APD (IN)	TOTAL (MBH)	TYPE	MERV				
AHU-1	MECHANICAL ROOM	MODULAR	11300	11300	2.00	20	FC	1100	109.9	0	100	180	160	6.0	0.44		2" PLEATED	8	480/3/60	TRANE	CSAA021	1,2,3,4,5,6

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. MAXIMUM COIL FACE VELOCITY SHALL NOT EXCEED 550 FPM.
3. COPPER COILS WITH ALUMINUM FINS.
4. PROVIDE INTERNAL VIBRATION ISOLATION AT SUPPLY FANS.
5. PROVIDE ACCESS SECTION BETWEEN COIL SECTIONS.
6. FAN SHALL BE SELECTED SO THAT FAN SURGE DOES NOT OCCUR AS SPEED REDUCES TO MINIMUM AIRFLOW.

EXPANSION TANK SCHEDULE

TAG	LOCATION	TYPE	SERVICE	TANK VOLUME (GAL.)	MIN ACCEPTANCE VOLUME (GAL.)	TANK PRE-CHARGE (PSI)	MAKE	MODEL	NOTES
ET-1	MECHANICAL ROOM	DIAPHRAGM	HOT WATER	11.3	2.64	12	BELL & GOSSETT	D-40	1,2

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. INSTALL WITH SUPPORT RING.

AIR SEPARATOR SCHEDULE

TAG	LOCATION	TYPE	SERVICE	FLOW (GPM)	PIPESIZE (INCHES)	WPD (FT)	MAKE	MODEL	NOTES
AS-1	MECHANICAL ROOM	TANGENTIAL	HOT WATER	142.45	4	0.34	BELL & GOSSETT	ROLAIRTROL RL-4F	1,2

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. UNIT SHALL BE ASME CERTIFIED.

LOUVER SCHEDULE

TAG	LOCATION	SERVICE	TYPE	MODULAR OPENING SIZE		DEPTH (IN.)	AIRFLOW (CFM)	FREE AREA (SQ. FT.)	MAKE	MODEL	NOTES
				WIDTH (INCHES)	HEIGHT (INCHES)						
IL-1	MECHANICAL ROOM	INTAKE	STATIONARY	64	68	4	11300	16.59	RUSKIN	ELF375DX	1,2,3,5,6,7,8
EL-1	MECHANICAL ROOM	EXHAUST	STATIONARY	64	68	4	11300	16.59	RUSKIN	ELC375DX	1,2,3,5,6,7,8

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. FRONT STATIONARY DRAINABLE BLADE WITH INTEGRAL BACKDRAFT DAMPER.
3. STATIONARY DRAINABLE BLADE.
4. COMBINATION DRAINABLE BLADE.
5. 6063T6 EXTRUDED ALUMINUM CONSTRUCTION.
6. BIRDSCREEN MOUNTED ON EXTERIOR.
7. INSECT SCREEN MOUNTED ON INTERIOR.
8. KYNAR OR FLUOROPOLYMER FINISH ON ENTIRE LOUVER AND BIRDSCREEN. COLOR TO BE SELECTED BY OWNER.

CONTROL DAMPER SCHEDULE

TAG	TYPE	BLADES	MATERIAL	DUCT TYPE	MAKE	MODEL	NOTES
BD	BALANCING	OPPOSED	ALUMINUM	RECTANGULAR	RUSKIN	CD51	1,2,3,4
MD	MOTORIZED	PARALLEL	ALUMINUM	RECTANGULAR	RUSKIN	CD51	1,2,3,4
BDD	BACKDRAFT	PARALLEL	ALUMINUM	RECTANGULAR	RUSKIN	BD2A2	1,2,3,4

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. SEE DRAWINGS FOR SIZES, AIRFLOW, AND QUANTITY.
3. PROVIDE WITH LOCKING QUADRANT.
4. PROVIDE 120/1/60 DAMPER MOTOR OPERATOR.

AIR OUTLETS SCHEDULE

TAG	SERVICE	TYPE	STATIC P.D. (IN. W.C.)	PATTERN	MATERIAL	FINISH	MAKE	MODEL	NOTES
SR	SUPPLY	REGISTER	0.08	DOUBLE DEFLECTION	ALUMINUM	CLEAR ANODIZED	TITUS	350FS	1,2,3,4
EG	EXHAUST	GRILLE	0.08	EGGCRATE	ALUMINUM	CLEAR ANODIZED	TITUS	50F	1,2,3,4

NOTES:
1. INSTALL PER MANUFACTURERS INSTRUCTIONS.
2. SEE DRAWING FOR SIZES, AIRFLOW, AND QUANTITY.
3. INTEGRAL BALANCING DAMPER.
4. DUCT MOUNTING.

THE CITY OF Kalamazoo

HVAC SCHEDULE

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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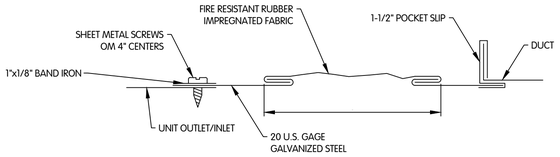
DESIGNED	DRAWN	CHECKED
LMM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.
H-2
31 OF 44

KAL-77250\H06-HVAC SCHEDULE
2/8/2022 2:42 PM - SWILLIS



TYPICAL FLEXIBLE CONNECTION DETAIL
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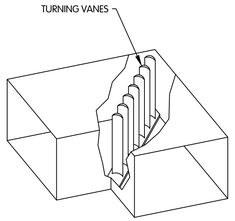

TYPICAL DUCT ELBOW DETAIL
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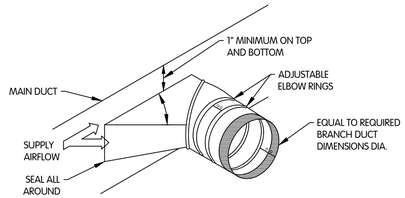

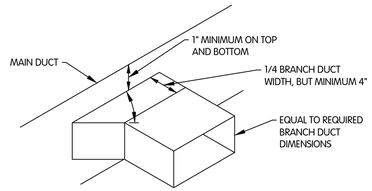

TYPICAL BRANCH TAKE-OFF FITTING DETAIL
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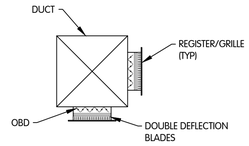

DUCT MOUNTED REGISTER/GRILLE DETAIL
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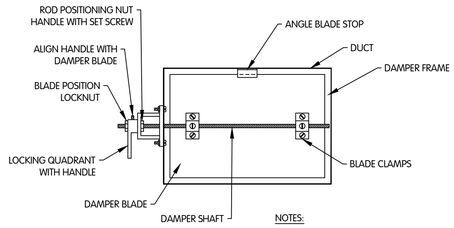
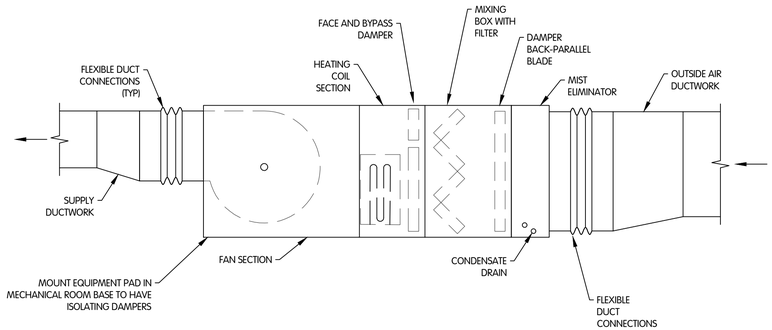


NOTES:

1. DAMPERS FOR ROUND DUCTS SHALL BE SIMILAR TO THE DAMPER SHOWN ABOVE.
2. ENSURE THAT FULL 90 DEGREE DAMPER BLADE MOVEMENT IS UNOBSTRUCTED.
3. FOR DUCT HEIGHTS MORE THAN 12 INCHES, PROVIDE OPPOSED BLADE DAMPERS.

MANUAL BALANCING DAMPER DETAIL
NTS



AIR HANDLING UNIT DETAIL
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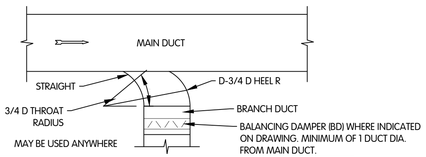

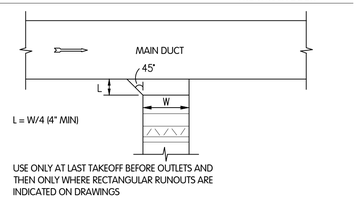

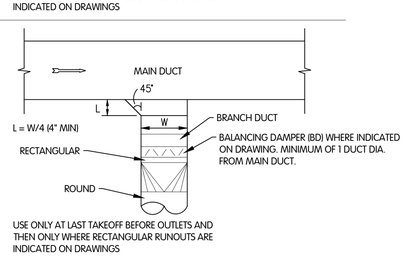

TYPICAL BRANCH CONNECTION DETAIL
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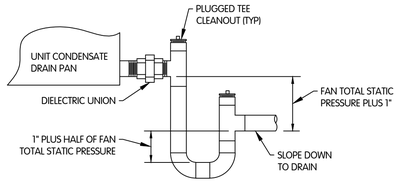
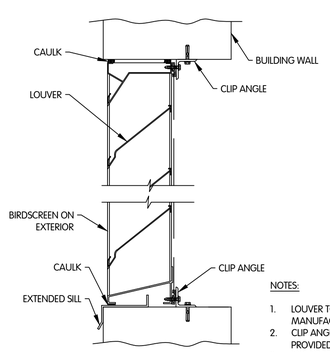


NOTES:

1. LOCATE TRAP AS CLOSE AS POSSIBLE TO CONDENSATE DRAIN PAN OUTLET WITH BOTTOM BELOW SUPPORT STRUCTURE.
2. DRAIN PIPING SHALL BE INSULATED.
3. SIZE OF TRAP PIPING TO BE LARGER OF EQUIPMENT OUTLET SIZE OR DIMENSION OF PLANS.
4. DRAIN PIPING SHALL PENETRATE THE ROOF LINE WITHIN THE CONFINEMENT OF THE HVAC EQUIPMENT CURB.

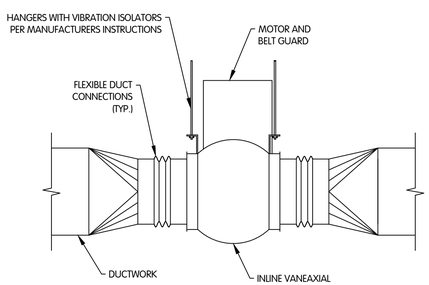
CONDENSATE DRAIN TRAP DETAIL
NTS



NOTES:

1. LOUVER TO BE ASSEMBLED AT LOUVER MANUFACTURER FACTORY.
2. CLIP ANGLES AND EXTENDED SILL TO BE PROVIDED BY LOUVER MANUFACTURER.
3. INSTALLATION OF LOUVER TO BE IN ACCORDANCE WITH LOUVER MANUFACTURER'S RECOMMENDATIONS.

TYPICAL STATIONARY LOUVER DETAIL
NTS



INLINE VANEAXIAL FAN DETAIL
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KAL-772500\H0G-HVAC DETAILS
JAMES HENRY
1/28/2022 2:33 PM - SWILLIS

THE CITY OF Kalamazoo

HVAC DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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SCALE NONE

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

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LMM	CJAF	AJD

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DATE: FEBRUARY 2022

SHEET NO.
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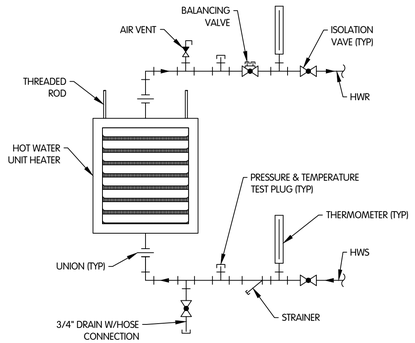
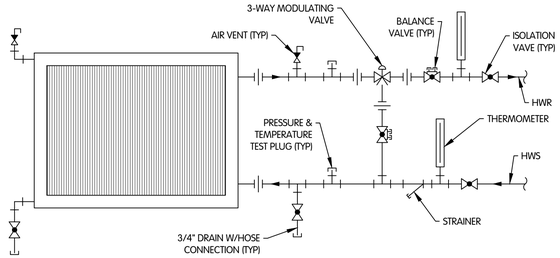
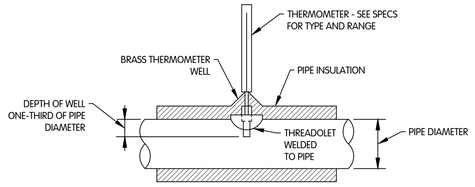
32 OF 44



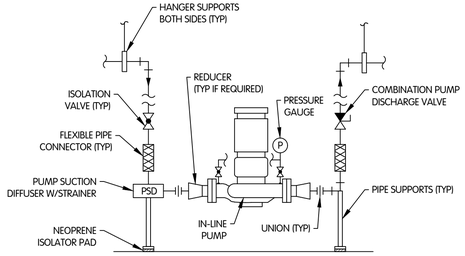
HOT WATER UNIT HEATER DETAIL
NTS



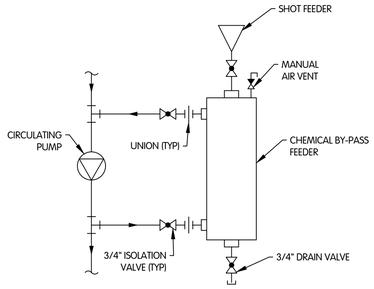
UNIT COIL PIPING DETAIL (3-WAY VALVE)
NTS



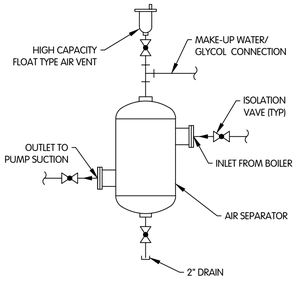
THERMOMETER IN INSULATED PIPE DETAIL
NTS



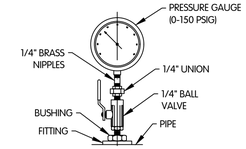
VERTICAL IN-LINE PUMP DETAIL
NTS



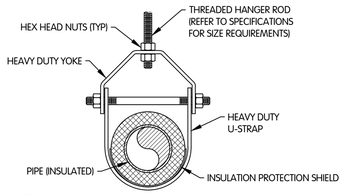
CHEMICAL BY-PASS FEEDER DETAIL
NTS



AIR SEPARATOR DETAIL
NTS



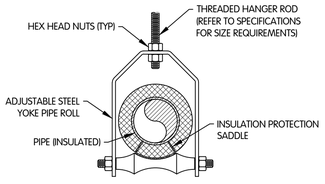
PRESSURE GAUGE DETAIL
NTS



NOTES:

1. UTILIZE ADJUSTABLE CLEVIS HANGERS FOR HEATING OR CHILLED WATER PIPING 2-1/2 INCH DIAMETER AND SMALLER.
2. OVERSIZE CLEVIS HANGER AS REQUIRED TO ALLOW FOR INSULATING PIPING WITHIN HANGER.
3. PROVIDE PIPE INSULATION PROTECTION SHIELD BETWEEN INSULATION AND CLEVIS.

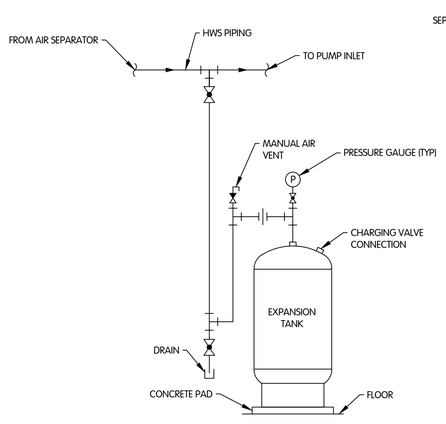
ADJUSTABLE CLEVIS PIPE HANGER INSTALLATION DETAIL
NTS



NOTES:

1. UTILIZE ROLL HANGER FOR ALL HEATING OR CHILLED WATER PIPING 3 INCH DIAMETER AND LARGER.
2. OVERSIZE ROLL HANGER AS REQUIRED TO ALLOW FOR INSULATING PIPING WITHIN HANGER.
3. PROVIDE PIPE INSULATION PROTECTION SHIELD BETWEEN INSULATION AND CLEVIS.

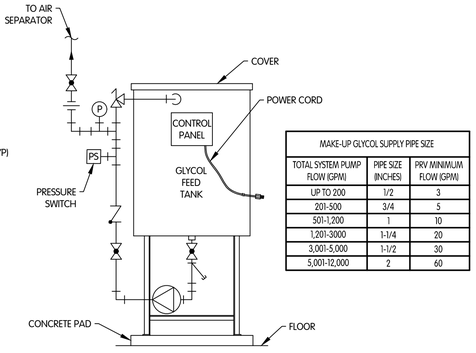
ADJUSTABLE STEEL YOKE PIPE ROLL HANGER INSTALLATION DETAIL
NTS



NOTES:

1. CONNECT TO SIDE OF MAIN TO PREVENT AIR OR DEBRIS FROM ENTERING PIPE TO TANK. TOP OR BOTTOM CONNECTION NOT PERMITTED.
2. PROVIDE ANTI THERMOSYPHON LOOP TO PREVENT GRAVITY HEATING OF TANK.

EXPANSION TANK DETAIL
NTS

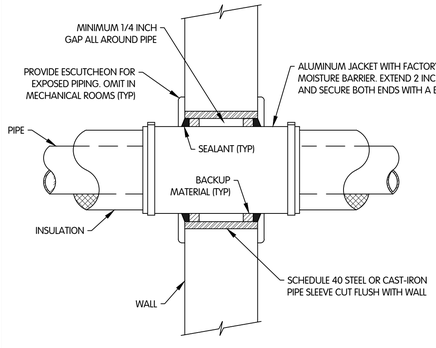


MAKE-UP GLYCOL SUPPLY PIPE SIZE		
TOTAL SYSTEM PUMP FLOW (GPM)	PIPE SIZE (INCHES)	PRV MINIMUM FLOW (GPM)
UP TO 200	1/2	3
201-500	3/4	5
501-1,200	1	10
1,201-3000	1-1/4	20
3,001-5,000	1-1/2	30
5,001-12,000	2	60

NOTES:

1. GLYCOL FEED TANK AND PIPING UPSTREAM OF THE PRESSURE GAUGE IS PROVIDED BY MANUFACTURER'S PACKAGED GYLCOL FEED SYSTEM.
2. PROVIDE A 120/1/60 ELECTRICAL RECEPTACLE NEAR UNIT TO ACCEPT POWER PLUG CONNECTION.

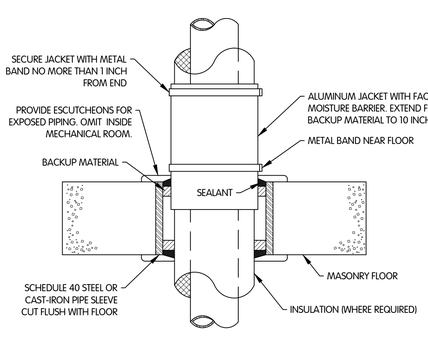
GLYCOL FEED SYSTEM CONNECTION DETAIL
NTS



NOTES:

1. FOR GYPSUM BOARD WALLS PROVIDE MINIMUM 16 GAUGE GALVANIZED STEEL SLEEVE W/LOCK-TYPE LONGITUDNAL SEAM.
2. OMIT ALUMINUM JACKET IF PIPING IS UNINSULATED.

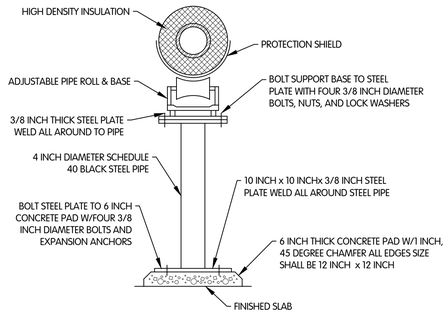
WALL PIPE PENETRATION DETAIL
NTS



NOTES:

1. OMIT ALUMINUM JACKET IF PIPING IS UNINSULATED.

FLOOR PIPE PENETRATION DETAIL
NTS



NOTES:

1. FOR USE IN EQUIPMENT ENCLOSURE AREAS.
2. FOR CHILLED WATER PIPING 4 INCH DIAMETER AND LARGER.

CHILLED WATER INSULATED PIPE SUPPORT DETAIL
NTS

THE CITY OF Kalamazoo

HVAC HYDRONIC WATER CONNECTION DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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KAL-772500H03-HVAC HYDRONIC WATER CONNECTION DETAILS
/2772500H03 - SWILLIS
1/28/2022 2:33 PM

HYDRONIC HEATING SYSTEM

HOT WATER SYSTEM SEQUENCE OF OPERATION:

THE HOT WATER BOILER HWB-1 LOCATED IN THE MECHANICAL ROOM SHALL BE CONTROLLED BY IT'S OWN CONTROL PANEL AND AQUASTAT TO SUPPLY HOT WATER TO THE SYSTEM. THE BOILER CONTROL PANEL SHALL BE INITIATED AND THE BOILER SHALL BE ALLOWED TO FIRE VIA AN OUTDOOR AIR THERMOSTAT WHEN THE TEMPERATURE REACHES 55 DEGREES F OR LESS. AUXILIARY RELAYS AT THE BOILER CONTROL PANEL SHALL ACTIVATE HOT WATER CIRCULATION PUMP HWP-1 WHEN BOILER IS ACTIVATED.

LEAD HOT WATER CIRCULATION PUMP HWP-1 ALSO LOCATED IN THE MECHANICAL ROOM SHALL CIRCULATE HOT WATER THROUGH SUPPLY AND RETURN PIPING SYSTEM TO THE HEATING EQUIPMENT. HWP-1 SHALL BE CONTROLLED BY A HAND-OFF-AUTO (HOA) SWITCH. IN THE AUTO MODE, HWP-1 SHALL BE INTERLOCKED AND AUTOMATICALLY ACTIVATED BY HWB-1.

HOT WATER CIRCULATION PUMP HWP-2 IS THE LAG PUMP. THE TWO HOT WATER CIRCULATION PUMPS SHALL OPERATE IN A LEAD/LAG FASHION. LEAD PUMP HWP-1 SHALL RUN FIRST. ON FAILURE OF THE LEAD PUMP, THE LAG PUMP SHALL RUN AND THE LEAD PUMP SHALL TURN OFF.

HOT WATER UNIT HEATERS (HWUH) SEQUENCE OF OPERATION:

HOT WATER UNIT HEATERS SHALL BE CONTROLLED BY A SINGLE TEMPERATURE, WALL-MOUNTED THERMOSTAT THAT MAINTAINS SPACE TEMPERATURE BY CYCLING UNIT FAN MOTOR.

ELECTRICAL ROOM

FAN COIL UNIT/CONDENSING UNIT (FC-1/CU-1 & FC-2/CU-2) SEQUENCE OF OPERATION:

ELECTRICAL ROOM SHALL BE COOLED BY TWO DUCTLESS SPLIT SYSTEMS CONSISTING OF AN INDOOR FAN COIL UNIT FC AND OUTDOOR CONDENSING UNIT CU. CONTROL THE SYSTEM BY A SINGLE STAGE COOL, HARD WIRED THERMOSTAT. ENERGIZE FC FAN AND CU COMPRESSOR/CONDENSER FAN WHENEVER THE THERMOSTAT CALLS FOR COOLING. COMPRESSOR/CONDENSER FAN SHALL RUN SUBJECT TO THEIR OWN INTERNAL SAFETIES AND CONTROLS. DE-ENERGIZE THE COOLING AND FAN WHEN THERMOSTAT HAS REACHED SET-POINT. DE-ENERGIZE CU AND FC FAN WHEN THERMOSTAT HAS REACHED SET-POINT.

BIOFILTRATION BUILDING AHU-1/EF-1

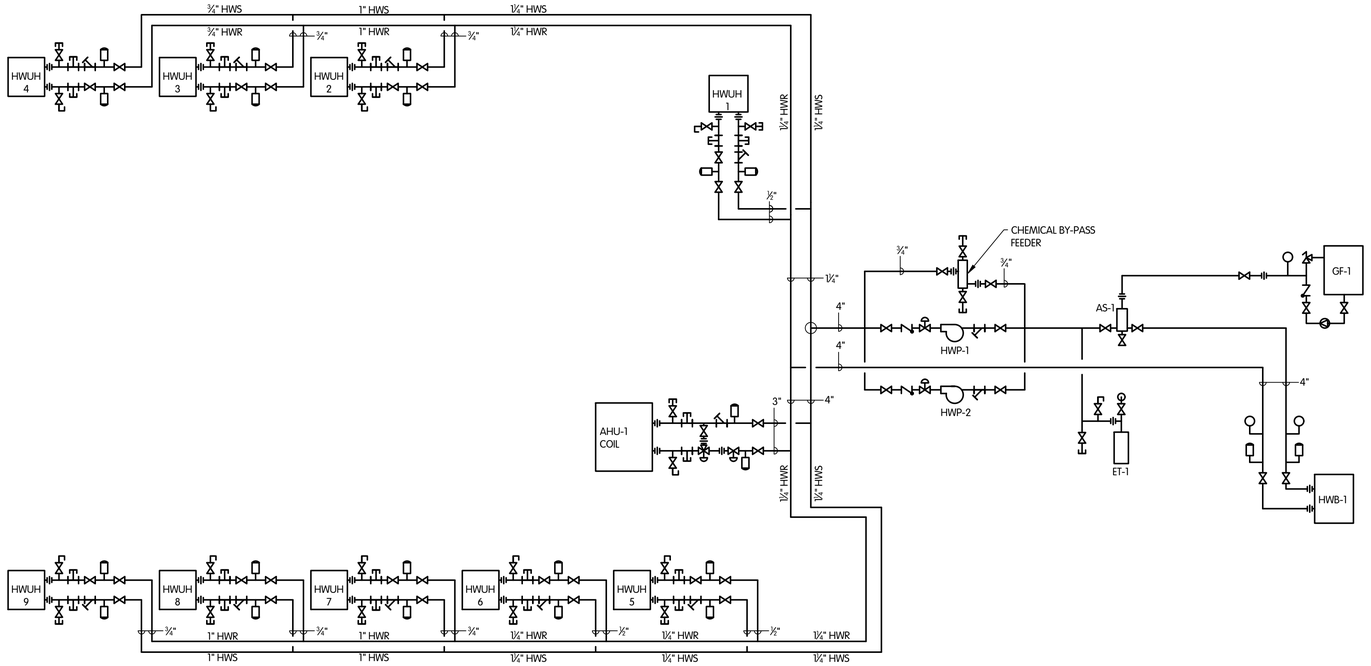
BIOFILTRATION BUILDING MAKE-UP AIR HANDLING UNIT AHU-1 AND EXHAUST FAN EF-1 SEQUENCE OF OPERATION:

HEATING AND VENTILATION FOR THE BIO-FILTRATION BUILDING SHALL BE SUPPLIED BY MAKE-UP AIR HANDLING UNIT AHU-1 AND DUCT MOUNTED INLINE EXHAUST FAN EF-1. EF-1 SHALL BE CONTROLLED BY A "HAND-OFF-AUTO" (HOA) SWITCH. WHEN THE SWITCH IS IN THE HAND POSITION, THE EF-1 MOTOR SHALL BE ACTIVATED. WHEN THE SWITCH IS IN THE OFF POSITION, EF-1 MOTOR SHALL BE DE-ACTIVATED, WHEN THE SWITCH IS IN THE AUTO POSITION, EF-1 MOTOR SHALL BE INTERLOCKED WITH AHU-1 SUPPLY FAN. MAKE-UP AIR FOR EF-1 SHALL BE PROVIDED BY AHU-1 THAT IS DUCTED TO THE SPACE. THE SYSTEM SHALL RUN CONTINUOUSLY AND PROVIDE 6 AIR CHANGES PER HOUR OF AIRFLOW TO THE SPACE.

AHU-1 SUPPLY FAN SHALL RUN CONTINUOUSLY AND BE CONTROLLED BY AN HOA SWITCH, CONTROL PANEL, SUPPLY AND OUTSIDE AIR DUCT MOUNTED THERMOSTATS, AND SAFETY CONTROL DEVICES. A THERMOSTAT MOUNTED IN THE SUPPLY DUCTWORK DOWNSTREAM OF THE UNIT SHALL SENSE THE DISCHARGE AIR TEMPERATURE. A THERMOSTAT MOUNTED IN THE OUTSIDE AIR DUCTWORK UPSTREAM OF THE UNIT SHALL SENSE INLET (OUTSIDE) AIR TEMPERATURE.

WHEN OUTSIDE AIR THERMOSTAT SENSES A TEMPERATURE ABOVE 40° F, THE SUPPLY AIR THERMOSTAT SHALL MODULATE THE FACE AND BYPASS DAMPERS AND HOT WATER COIL 3-WAY CONTROL VALVE IN CONCERT TO MAINTAIN A LEAVING AIR TEMPERATURE OF 55° F. WHEN OUTSIDE AIR THERMOSTAT SENSES A TEMPERATURE BELOW 40° F, THE SUPPLY AIR THERMOSTAT SHALL MODULATE THE HOT WATER COIL 3-WAY CONTROL VALVE TO 100% FULL OPEN AND MODULATE FACE AND BYPASS DAMPERS TO MAINTAIN A LEAVING AIR TEMPERATURE OF 55° F.

SAFETY AND AIRFLOW DEVICES SHALL CONSIST OF THE FOLLOWING. A FREEZE PROTECTION THERMOSTAT MOUNTED ON THE DOWNSTREAM FACE OF THE UNIT COIL SHALL DEACTIVATE AHU-1 FAN WHEN A TEMPERATURE OF BELOW 40° F IS SENSED, BYPASS DAMPER SHALL GO TO FULL OPEN AND FACE DAMPER SHALL GO TO FULL CLOSED. A SIGNAL ALARM LIGHT "COIL FREEZE" SHALL BE LIGHTED ON THE AHU-1 CONTROL PANEL. A DUCT MOUNTED SMOKE DETECTOR SD LOCATED IN THE EXHAUST FAN EF-1 DUCTWORK SHALL DEACTIVATE AHU-1 FAN AND EF-1 WHENEVER SMOKE IS DETECTED AND SIGNAL ALARM LIGHT "SMOKE" ON AHU-1 CONTROL PANEL. DIFFERENTIAL PRESSURE SWITCH PS SHALL SIGNAL INDICATOR LIGHT "FAN ON" ON AHU-1 CONTROL PANEL WHENEVER THE FAN IS IN OPERATION. DIFFERENTIAL PRESSURE SWITCH PS SHALL SIGNAL INDICATOR LIGHT "DIRTY FILTER" ON AHU-1 CONTROL PANEL UPON SENSING A CLOGGED FILTER ON AHU-1.

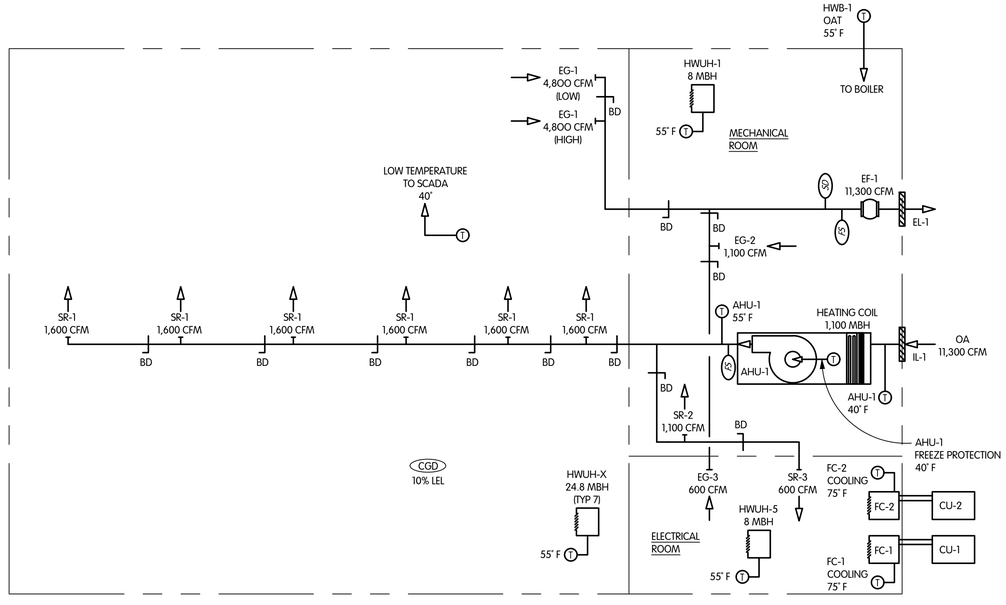


HWUH PIPING SCHEMATIC

LEGEND

HWUH =	HOT WATER UNIT HEATER
HWB =	HOT WATER BOILER
HWP =	HOT WATER PUMP
AHU =	AIR HANDLER UNIT
AS =	AIR SEPARATOR
BD =	BALANCING DAMPER
CU =	CONDENSER UNIT
ET =	EXPANSION TANK
GF =	GLYCOL FEED SYSTEM
CGD =	COMBUSTIBLE GAS DETECTOR
FS =	FLOW SWITCH
SD =	SMOKE DETECTOR
FC=	FAN COIL
(T) =	THERMOSTAT

NOTE: ALL NUMBERS CFM UNLESS NOTED.



BIOFILTER AIRFLOW SCHEMATIC

THE CITY OF Kalamazoo

HVAC SCHEMATICS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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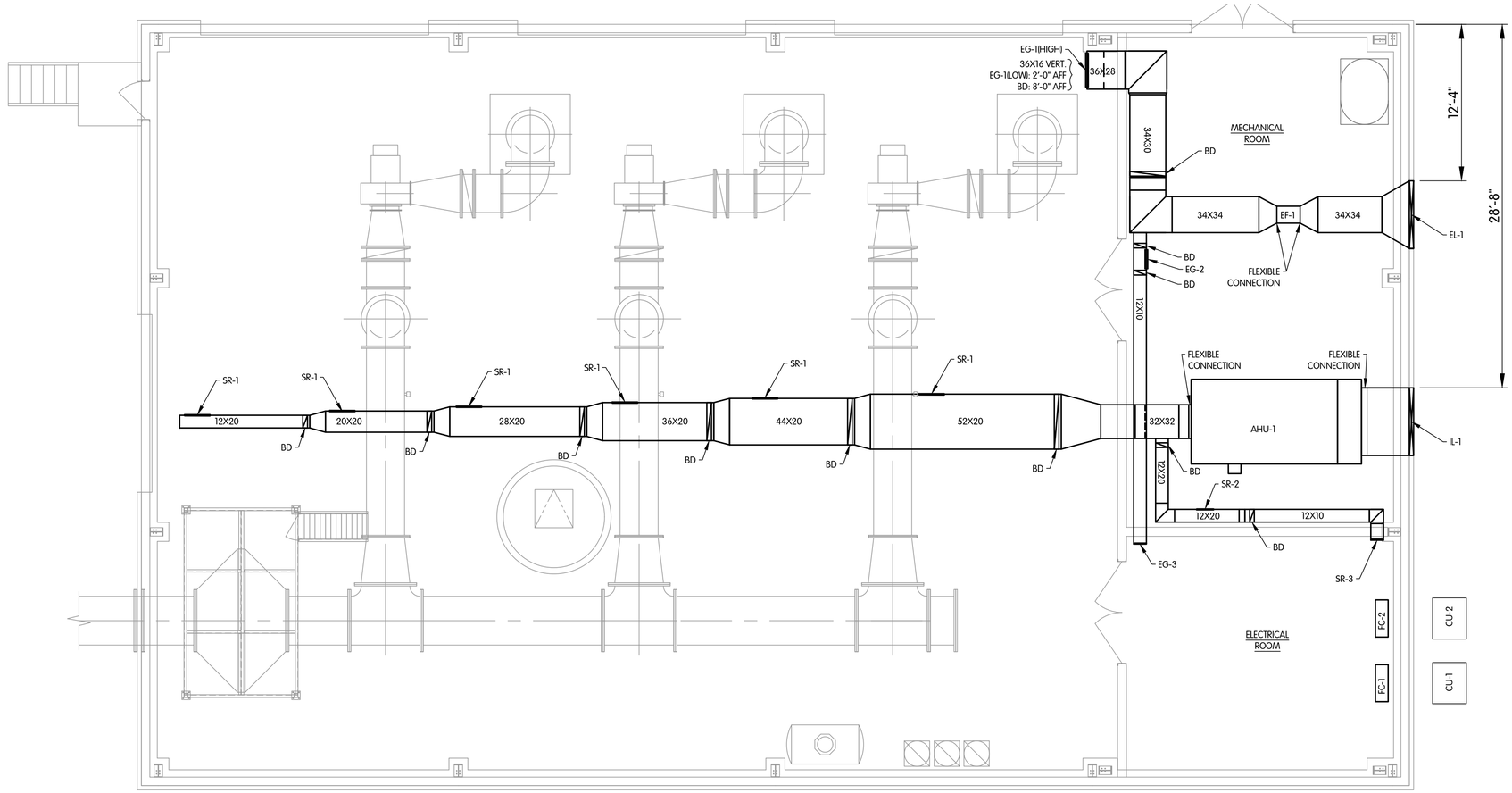
KAL-7725001H05-HVAC SCHEMATICS
1/20/2022 2:34 PM S SWILLIS
1/20/2022 2:33 PM

LEGEND

AHU = AIR HANDLER UNIT
CU = CONDENSING UNIT
IL = INTAKE LOUVER
EL = EXHAUST LOUVER
EF = EXHAUST FAN
SR = SUPPLY REGISTER
EG = EXHAUST GRILLE
BD = BALANCING DAMPER
FC = FAN COIL

SR-1 = SIZE/CFM: 24X16/1,600
SR-2 = SIZE/CFM: 16X16/1,100
SR-3 = SIZE/CFM: 12X12/600
EG-1 = SIZE/CFM: 32X32/4,800
EG-2 = SIZE/CFM: 18X14/1,100
EG-3 = SIZE/CFM: 12X12/600

NOTES:
1. AIR SUPPLY DUCTING TO BE 14'-0" ABOVE FINISHED FLOOR.
2. EXHAUST DUCTING TO BE 10'-0" ABOVE FINISHED FLOOR.



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BLOWER BUILDING
HVAC PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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SHEET NO.
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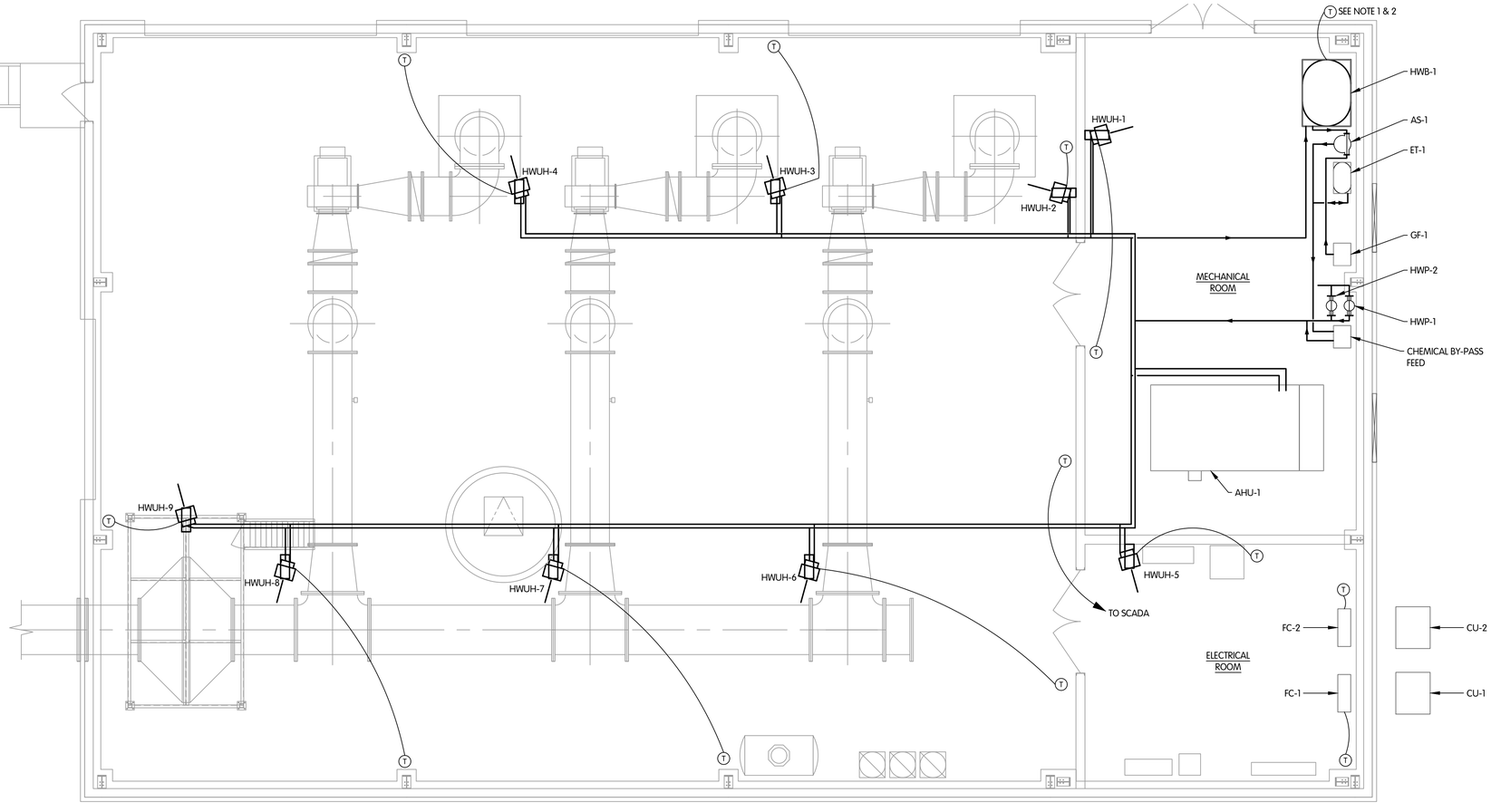
35 OF 44

KAL-7725001H0-BLOWER BUILDING HVAC PLAN
1/28/2022 11:14 AM - SWILLIS
1/28/2022 2:33 PM

LEGEND

HWUH = HOT WATER UNIT HEATER
HWB = HOT WATER BOILER
HWP = HOT WATER PUMP
AHU = AIR HANDLER UNIT
AS = AIR SEPARATOR
BD = BALANCING DAMPER
CU = CONDENSER UNIT
ET = EXPANSION TANK
GF = GLYCOL FEED SYSTEM
(T) = THERMOSTAT

NOTES:
1. OUTSIDE AIR THERMOSTAT.
2. PROVIDE SUN SHIELD.



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THE CITY OF Kalamazoo

BLOWER BUILDING HYDRONIC PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

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SHEET NO.

H-7

36 OF 44

K:\KAL-7725001H07-BLOWER BUILDING HYDRONIC PLAN
1/28/2022 2:53 PM
1/28/2022 2:53 PM
LMM
I:\28\2022 2:53 PM
1/28/2022 2:53 PM
S WILLIS

SINGLE-LINE DIAGRAM LEGEND

30A
FRS-R -30
FUSED DISCONNECT SWITCH.
(SWITCH SIZE, FUSE TYPE AND FUSE SIZE AS SHOWN)

30A
UNFUSED DISCONNECT SWITCH
(SWITCH SIZE AS SHOWN)

40A
THERMAL-MAGNETIC CIRCUIT BREAKER OR MOTOR CIRCUIT PROTECTOR-MCP
(TRIP SIZE AS SHOWN)

CB
HIGH OR MEDIUM VOLTAGE CIRCUIT BREAKER

12470
1000KVA
480Y/277V
LIGHTING OR POWER TRANSFORMER,THREE PHASE UNLESS NOTED OTHERWISE (CONNECTION, SIZE & RATING AS SHOWN)

FULL VOLTAGE NON-REVERSING MOTOR STARTER WITH OVERLOADS (FVNR)

R F
FULL VOLTAGE REVERSING MOTOR STARTER WITH OVERLOADS
(FVR)

S F
TWO SPEED MOTOR STARTER WITH OVERLOADS

VACUUM CONTACTOR

5
THREE PHASE AC MOTOR
(HORSEPOWER AS SHOWN)

600/5 AS AM
CURRENT TRANSFORMER WITH AMMETER SWITCH, AND AMMETER
(RATIO AS SHOWN)

600/5
CURRENT TRANSFORMER WITH SHORTING BLOCK (RATIO AS SHOWN)

VS VM
POTENTIAL TRANSFORMER WITH VOLTMETER SWITCH, AND VOLTMETER

6KV
LIGHTNING ARRESTER
(VOLTAGE RATING AS SHOWN)

TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS)

GROUND CONNECTION

LINE OR LOAD REACTOR

K
KIRK KEY
(DASHED LINES TO INTERLOCKED DEVICES)

DRAWOUT FOR SWITCHGEAR OR MOTOR CONTROL CENTER

POWER FACTOR CORRECTION CAPACITOR - (PFCC) (SIZE PER MOTOR MANUFACTURER RECOMMENDATIONS.)

100E
HIGH OR MEDIUM VOLTAGE FUSED CUTOUT (SIZE AS SHOWN)

4/0
CABLE LIMITER (SIZE AS SHOWN)

G
450KW
800A
STAND-BY GENERATOR
(SIZE AS SHOWN)
WITH FIELD PROTECTION CIRCUIT BREAKER
(TRIP SIZE AS SHOWN)

VFD BP
VARIABLE FREQUENCY DRIVE WITH A BY-PASS OPTION (SHOWN WITH INTEGRAL EXTERNAL DISCONNECT HANDLE)

CP = CONTROL PANEL
SSRVS = SOLID STATE REDUCED VOLTAGE STARTER
(SHOWN WITH INTEGRAL EXTERNAL DISCONNECT HANDLE)

DPM
DIGITAL POWER METER

WHM
WATTHOUR METER

AUTOMATIC TRANSFER SWITCH (ATS)

MANUAL TRANSFER SWITCH (MTS)

SCHEMATIC LEGEND

OPEN CONTACTS
WITH TIME-DELAY CLOSING

CLOSED CONTACTS
WITH TIME-DELAY OPENING

OPEN CONTACTS
WITH TIME-DELAY OPENING

CLOSED CONTACTS
WITH TIME-DELAY CLOSING

FLOW SWITCH
CLOSES ON INCREASE IN FLOW

FLOW SWITCH
OPENS ON INCREASE IN FLOW

LIQUID LEVEL SWITCH CLOSES ON RISING LEVEL

LIQUID LEVEL SWITCH OPENS ON RISING LEVEL

PRESSURE OR VACUUM SWITCH CLOSES ON RISING PRESSURE

PRESSURE OR VACUUM SWITCH OPENS ON RISING PRESSURE

TEMPERATURE SWITCH
CLOSES ON RISING TEMPERATURE

TEMPERATURE SWITCH
OPENS ON RISING TEMPERATURE

LIMIT SWITCH
NORMALLY OPEN

LIMIT SWITCH
NORMALLY OPEN - HELD CLOSED

LIMIT SWITCH NORMALLY CLOSED

LIMIT SWITCH
NORMALLY CLOSED - HELD OPEN

FOOT SWITCH
OPENS BY FOOT PRESSURE

FOOT SWITCH
CLOSES BY FOOT PRESSURE

MUSHROOM HEAD, MAINTAINED ACTION (PUSH-PULL) PUSH BUTTON SWITCH (SHOWN WITH ONLY 1 CIRCUIT)

ON OFF
XO
2 - POSITION, MAINTAINED ACTION SELECTOR SWITCH

H O A
XOO
OOX
3 - POSITION, MAINTAINED ACTION SELECTOR SWITCH
H - O - A: HAND-OFF-AUTOMATIC
L - O - R: LOCAL-OFF-REMOTE
PCS: PLANT CONTROL SYSTEM
PLC: PROGRAMMABLE LOGIC CONTROLLER

INDICATES ITEMS IN A SEPARATE COMMON ENCLOSURE

XY
CONTACTOR COIL
M - MOTOR STARTER CONTACTOR
MF - MOTOR STARTER FORWARD CONTACTOR
MR - MOTOR STARTER REVERSE CONTACTOR
ML - MOTOR STARTER LOW SPEED CONTACTOR
MH - MOTOR STARTER HIGH SPEED CONTACTOR
SC - MOTOR STARTER STARTING CONTACTOR
RC - MOTOR STARTER RUN CONTACTOR
BP - BYPASS CONTACTOR
CC - CAPACITOR CONTACTOR
LC - LIGHTING CONTACTOR
IC - ISOLATION CONTACTOR
C - GENERAL CONTACTOR

XR
CONTROL RELAY COIL
CR - INSTANTANEOUS CONTROL RELAY
TR - TIME DELAY RELAY

OL
MOTOR STARTER OVERLOAD RELAY N.C. CONTACT

SOLENOID COIL
SV - SOLENOID VALVE

ETM
ELAPSED TIME METER

NORMALLY OPEN MOMENTARY ACTION PUSHBUTTON SWITCH
(SHOWN WITH ONLY 1 CIRCUIT)

NORMALLY CLOSED MOMENTARY ACTION PUSHBUTTON SWITCH
(SHOWN WITH ONLY 1 CIRCUIT)

R
PUSH-TO-TEST PILOT LIGHT WITH COLORED LENS CAP
R - RED
G - GREEN
A - AMBER
W - WHITE
B - BLUE
CL - CLEAR

F
ZERO SPEED SWITCH
(NORMALLY OPEN)

F
ZERO SPEED SWITCH
(NORMALLY CLOSED)

ELECTRICAL PLAN LEGEND

G — GROUND WIRE
DIRECT BURIAL CABLE
CONDUIT CONCEALED
CONDUIT EXPOSED
CONDUIT IN CONCRETE DUCT BANK
HOMERUN
CONDUIT TURNS UP
CONDUIT TURNS DOWN
CAPPED CONDUIT (FUTURE USE)
CONDUIT TEE
CADWELD CONNECTION
B B — B = BUSWAY
C C — C = CABLE TRAY
S — SINGLE POLE TOGGLE SWITCH
S_2 — DOUBLE POLE TOGGLE SWITCH
S_3 — THREE-WAY TOGGLE SWITCH
S_4 — FOUR-WAY TOGGLE SWITCH
S_P — TOGGLE SWITCH WITH GREEN PILOT LIGHT
S_K — KEY-OPERATED SWITCH
5 — SINGLE RECEPTACLE
3 — DUPLEX RECEPTACLE
5 — RECEPTACLE, (SINGLE) 120,30A.OR LARGER
6,8 — RECEPTACLE, (SINGLE) 240V,2POLE
4,6,8 — POWER RECEPTACLE 480V,3PH WITH DISCONNECT SWITCH (SIZE AS SHOWN)
TELEPHONE RECEPTACLE
COMPUTER RECEPTACLE
BOLLARD LIGHT FIXTURE
B 2 — CEILING MOUNTED FIXTURE
C 1 — WALL MOUNTED FIXTURE
D 1 — POLE MOUNTED FIXTURE
A 2 — FLUORESCENT FIXTURE
A 2 — FLUORESCENT TROFFER - GRID CEILING LAY IN
E 1 — EMERGENCY LIGHTING FIXTURE, (2-HEAD SHOWN)
EXIT FIXTURE (WITH DIRECTION ARROW WHERE INDICATED)
MCC — MOTOR CONTROL CENTER (MCC) OR SWITCHGEAR (SWG)
DISTRIBUTION PANEL 480V OR 480Y/277V
LIGHTING PANEL 120/208V OR 120/240V
UPS — UNINTERRUPTIBLE POWER SUPPLY
EPP — EMERGENCY POWER PACK
CP — CONTROL PANEL (SHOWN WITH EXTERNAL DISCONNECT HANDLE)
MAGNETIC MOTOR STARTER 480V, 3 PHASE
MAGNETIC MOTOR STARTER 120V, 1 PHASE
COMBINATION MAGNETIC MOTOR STARTER 480V, 3 PHASE
COMBINATION MAGNETIC MOTOR STARTER 120V, 1 PHASE
S_M — MANUAL MOTOR STARTER 480V, 3 PHASE
S_V — MANUAL MOTOR STARTER 120V, 1 PHASE
DISCONNECT SWITCH (SEE SINGLE LINE DIAGRAM FOR SIZE & TYPE)
½ — SINGLE PHASE AC MOTOR(HORSEPOWER AS SHOWN,DC INDICATES DC MOTOR)

2 — THREE PHASE AC MOTOR(HORSEPOWER AS SHOWN)
MOTOR OPERATED VALVE, 3 PHASE,WITH MAGNETIC STARTER AND CONTROLS
MOTOR OPERATED VALVE, 1 PHASE,WITH MAGNETIC STARTER AND CONTROLS
GROUND ROD WITH CADWELD CONNECTION
PP — PP= POWER POLE, LP = LIGHT POLE
AIR TERMINAL (LIGHTNING PROTECTION)
F — STROBE LIGHT (F=FIRE ALARM, G=GAS ALARM)
R/F — HEAT DETECTOR - RATE OF RISE/FIXED TEMPERATURE
P — SMOKE DETECTOR - (P = PHOTOELECTRIC, I = IONIZATION)
F — PULL STATION - FIRE ALARM
HORN, BELL, OR SIREN
HORN/STROBE COMBINATION
CA — CAPACITOR
CONTROL STATION
JB — BOX - JUNCTION, TERMINAL, PULL OR HAND HOLE
M — ELECTRIC MANHOLE
XF — TRANSFORMER (SEE SINGLE LINE FOR SIZE & TYPE)
LC — LIGHTING CONTACTOR
FT — FLOW TRANSMITTER
LT — LEVEL TRANSMITTER
PT — PRESSURE TRANSMITTER
TT — TEMPERATURE TRANSMITTER
AT — ANALYSIS TRANSMITTER (I.E. OXYGEN, TURBIDITY)
PI — INDICATOR - PRESSURE, FLOW, LEVEL, DENSITY, ANALYSIS
DT — DENSITY TRANSMITTER
ZS — LIMIT (POSITION) SWITCH
PS — PRESSURE SWITCH
TS — TEMPERATURE SWITCH (I.E. MOTOR THERMO PROTECTOR)
CS — CONVEYOR CABLE SWITCH
SS — SPEED SWITCH
FS — FLOW SWITCH
LS — LEVEL SWITCH
NS — MOISTURE SENSOR
OS — TORQUE SWITCH
VS — VIBRATION SWITCH
LC — LOAD CELL
LE — TRANSMITTER SENSING ELEMENT - LEVEL, FLOW, DENSITY, PRESSURE, ANALYSIS
S — SOLENOID
T — THERMOSTAT
H — HEATER IN MOTOR
PC — PHOTOELECTRIC CELL
G — GAS DETECTOR WITH CONTROL PANEL (GAS TYPE AS SHOWN)
T — THERMOCOUPLE
V — PNEUMATIC VALVE OPERATOR
I — CURRENT TO PRESSURE TRANSDUCER

GENERAL ELECTRICAL ABBREVIATIONS

PVC - POLYVINYL CHLORIDE
RGS - RIGID GALVANIZED STEEL
PVC/RGS - PVC COATED RGS

MOTOR STARTER ABBREVIATIONS

FVNR - FULL VOLTAGE, NON-REVERSING
FVR - FULL VOLTAGE REVERSING
TS1W - TWO SPEED, ONE WINDING
TS2W - TWO SPEED, TWO WINDING
TSR1W - TWO SPEED REVERSING, ONE WINDING
TSR2W - TWO SPEED REVERSING, TWO WINDING

ELECTRICAL NOTES

1. STRUCTURAL MATERIALS ARE NOT SHOWN ON ELECTRICAL DRAWINGS. REFER TO ARCHITECTURAL AND STRUCTURAL DRAWINGS.
2. ALL ELECTRICAL EQUIPMENT ELEVATIONS SHOWN ARE TO BOTTOM OF DEVICE OR PANEL, UNLESS OTHERWISE NOTED.
3. NUMBER SHOWN # (I.E.1173.5), INDICATES A SPECIFICATION REFERENCE FOR ITEMS OTHER THAN DIVISION 16. THE ELECTRICAL ITEM UNDER THIS REFERENCE IS SUPPLIED BY ANOTHER PART OF THE CONTRACT. UNLESS OTHERWISE NOTED IN THAT SPECIFICATION, THE CONTRACTOR SHALL INSTALL AND WIRE THE ITEM PER THE DRAWINGS AND DIVISION 16 SPECIFICATIONS.
4. CONTROL WIRING SHALL CONFORM TO ALL REQUIREMENTS AS SHOWN ON THE P & ID DRAWINGS WHETHER SHOWN ON THE ELECTRICAL DRAWINGS OR NOT.
5. WHERE LINES ARE SHOWN CONNECTING ELECTRICAL EQUIPMENT, THEY ARE NOT INTENDED AS CONDUIT ROUTING. CONTRACTOR SHALL ROUTE ALL CONDUIT RUNS (SHOWN OR NOT) PER DIVISION 16 SPECIFICATIONS.
6. WP INDICATES WATERPROOF. LETTER ON OR NEXT TO LIGHT FIXTURE INDICATES TYPE, PER SECTION 16510. NUMBER WITH LIGHT FIXTURE OR RECEPTACLE INDICATES CIRCUIT NUMBER.
7. GFCI INDICATES A CIRCUIT BREAKER OR RECEPTACLE WITH A 6 MA GROUND FAULT CIRCUIT INTERRUPTER. GFEPD INDICATES A CIRCUIT BREAKER OR RECEPTACLE WITH A 30 MA GROUND FAULT EQUIPMENT PROTECTION DEVICE.
8. FOR BELOW GRADE CONDUIT PENETRATIONS THROUGH EXISTING EXTERIOR CONCRETE WALLS, PROVIDE TYPE A CONDUIT SLEEVE FOR PVC CONDUIT. FOR RGS OR PVC-COATED RGS CONDUIT, PROVIDE TYPE B CONDUIT SLEEVE THROUGH CONCRETE WALLS, AND TYPE C CONDUIT SLEEVE THROUGH EXISTING CONCRETE WALLS.
9. FOR ABOVE GRADE CONDUIT PENETRATIONS THROUGH EXTERIOR CONCRETE WALLS, PROVIDE TYPE C CONDUIT SLEEVE. FOR MASONRY WALLS PROVIDE TYPE F CONDUIT SLEEVE.
10. FOR CONDUIT PENETRATIONS THROUGH EXISTING CONCRETE FLOORS AND WALLS BETWEEN ADJACENT NON-CLASSIFIED (NON-HAZARDOUS) AREAS, PROVIDE TYPE C CONDUIT SLEEVES FOR ALL CONDUIT TYPES. FOR SIMILAR PENETRATIONS THROUGH CONCRETE FLOORS AND WALLS, PROVIDE TYPE D CONDUIT SLEEVES FOR ALL CONDUIT TYPES.
11. FOR CONDUIT PENETRATIONS THROUGH CONCRETE FLOORS AND WALLS SEPARATING CLASSIFIED (HAZARDOUS) AREAS FROM NON-CLASSIFIED (NON-HAZARDOUS) AREAS, PROVIDE TYPE G CONDUIT SLEEVES. FOR SIMILAR PENETRATIONS THROUGH MASONRY WALLS, PROVIDE TYPE H CONDUIT SLEEVE. FOLLOW MECHANICAL SEAL MANUFACTURER'S RECOMMENDATIONS TO MEET 3-HOUR FIRE RESISTANCE REQUIREMENTS.
12. LEGENDS ARE FOR REFERENCE ONLY AND DOES NOT MEAN THAT ALL ITEMS ARE USED.

THE CITY OF Kalamazoo

ELECTRICAL LEGEND

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
5		
4		
3		
2		
1		

REVISIONS AFTER ISSUED FOR BID

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JOB NO. 017-7725.001
SCALE NONE
THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE
DESIGNED PEM | DRAWN CJAF | CHECKED AJD
STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022
SHEET NO. E-1
37 OF 44

KAL-772500\E0\ELECTRICAL LEGEND
AMY.PRESTON
1/28/2022 2:33 PM
- SWILLIS

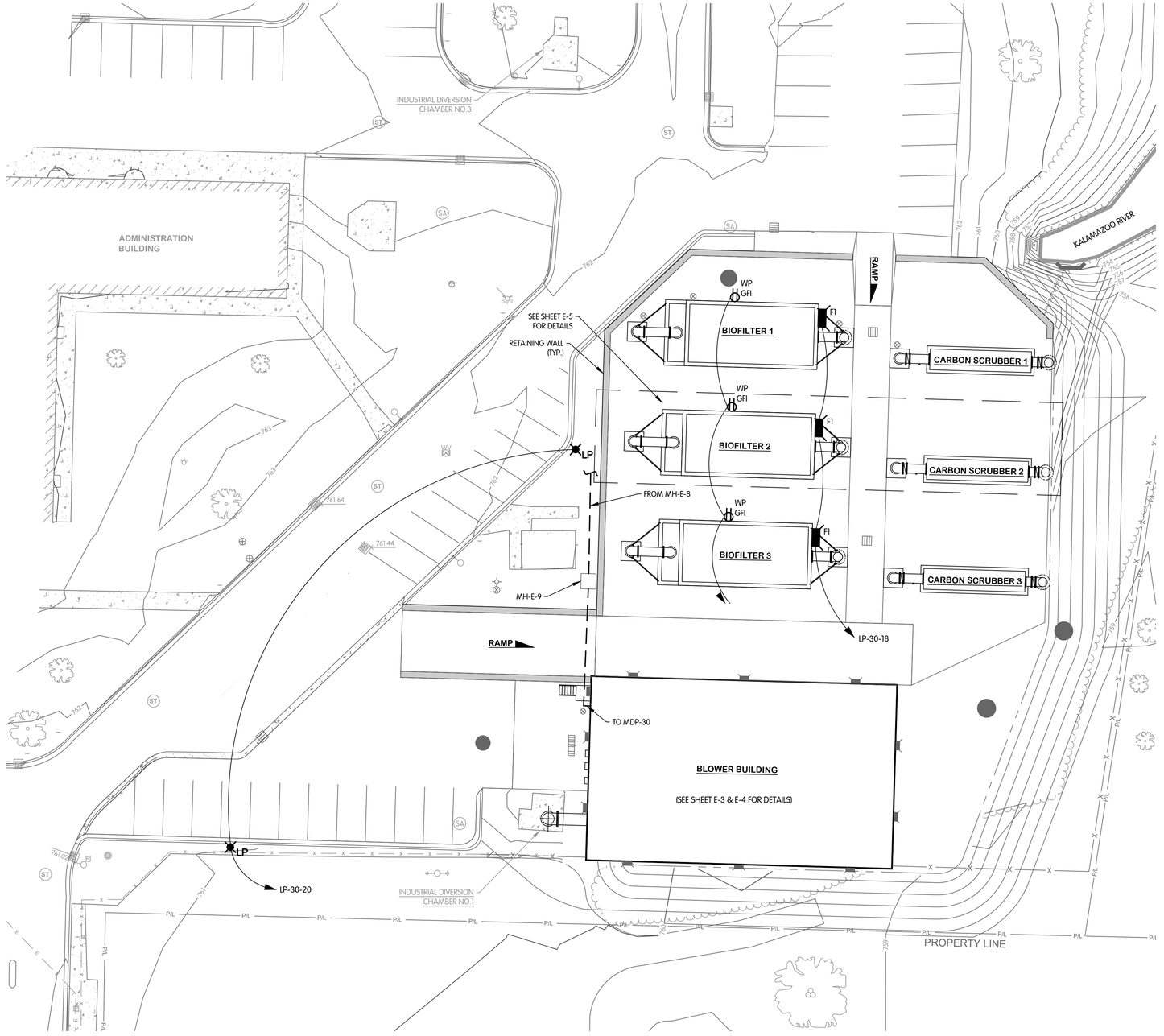
LIGHTING LEGEND		
TYPE	**DESCRIPTION**	**EQUAL TO**
	Type 2 Medium Distribution, Single Led Area Luminaire Mounted on a 30 Ft. Round Pole With Natural Aluminum Finish. Fixture Furnished With Integral Photo Cell Receptacle And Photocell. Fixture Shall Be Wired At 208V Unless Noted Otherwise.	*Lithonia Fixture:* *DSX2-LED-P1-50K-T2M-MVOLT-RPA-DNAXD/DLW27F1.5JU* *Pole:* *RTA 30-7E-DM19A5-DNA-VD-BC*

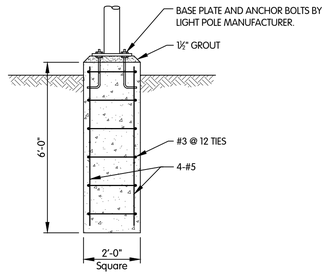
LEGEND

LP POLE MOUNTED LUMINAIRE

WALL PACK LUMINAIRE
(F1 SEE LIGHTING SCHEDULE ON SHEET E-3)

EXTERIOR LIGHTING:
1) ALL LUMINAIRES INDIVIDUALLY PHOTOCELL CONTROLLED.
2) 1.5-2 AVG FOOTCANDLES ON PAVEMENT.
3) ALL LIGHTING SHALL BE OF THE SAME DESIGN.





LIGHT POLE BASE DETAIL
NTS

THE CITY OF KALAMAZOO

LIGHTING SITE PLAN & DETAILS

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
1			
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3			
4			
5			

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JOB NO. 017-7725.001

SCALE 1" = 20'

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
PEM	CJAF	AJD

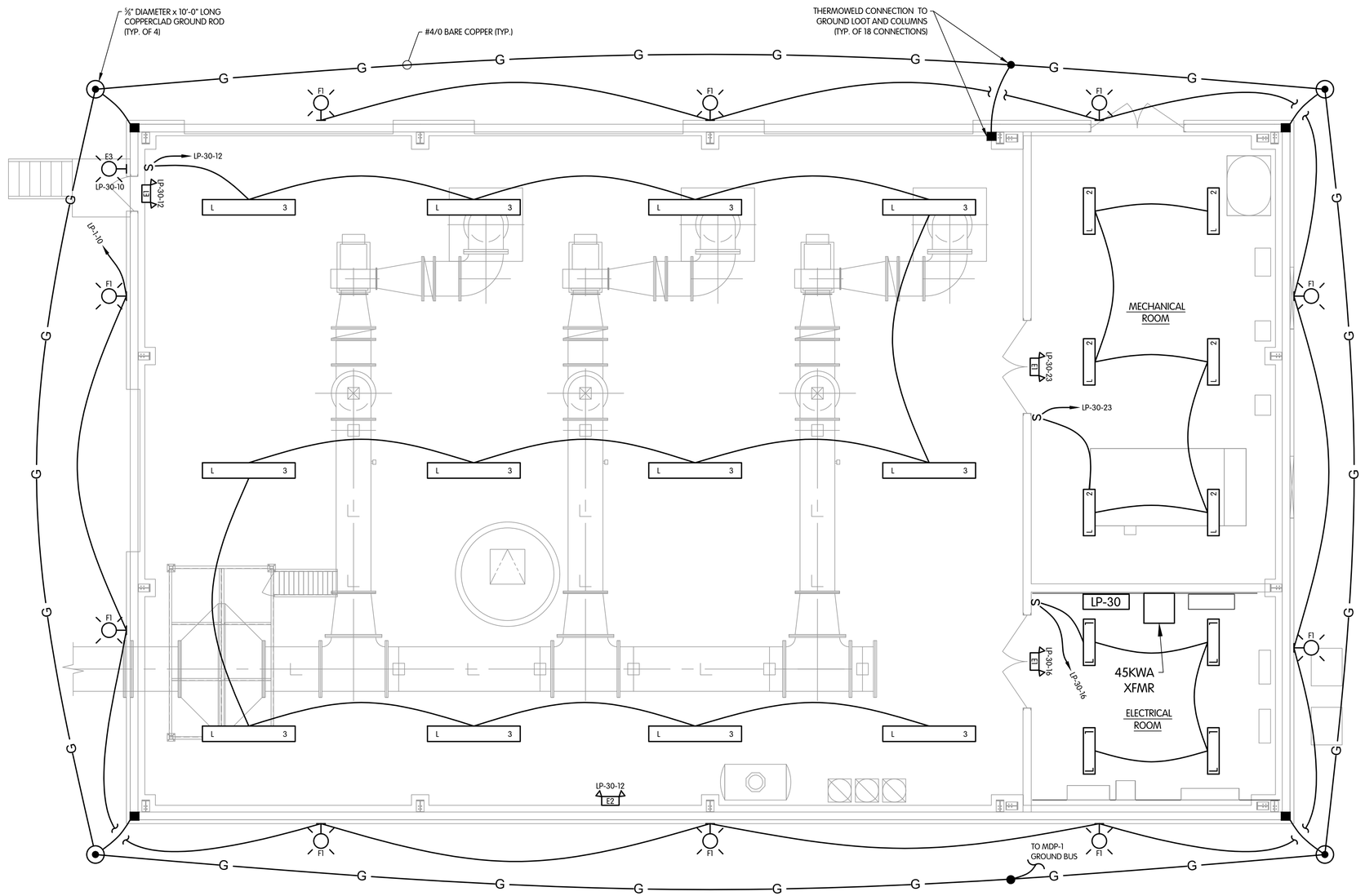
STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.
E-2
38 OF 44

KAL-772500IE02-LIGHTING SITE PLAN & DETAILS
I:/772500/IE/02-LIGHTING SITE PLAN & DETAILS.DWG - SWILLIS
1/28/2022 2:33 PM

BLOWER BUILDING LIGHTING SCHEDULE	
SYMBOL	DESCRIPTION
L 1	LITHONIA CAT. NO. FEM-L48-8000LW-IMACD-MD-MVOLT-40K-80CRI LINEAR LED, 8000 LUMENS, ACRYLIC CLEAR DEEP LENS, MEDIUM DISTRIBUTION, MULTIVOLT, 4000K, 80CRI, 50.5 WATTS. MOUNTED AT 14'-0" AFF
L 2	LITHONIA CAT. NO. FEM-L48-10000LW-IMACD-MD-MVOLT-40K-80CRI LINEAR LED, 10000 LUMENS, ACRYLIC CLEAR DEEP LENS, MEDIUM DISTRIBUTION, MULTIVOLT, 4000K, 80CRI, 62 WATTS. MOUNTED AT 14'-0" AFF
L 3	LITHONIA CAT. NO. FEM-L96-15000LW-IMACD-MD-MVOLT-40K-80CRI LINEAR LED, 15000 LUMENS, ACRYLIC CLEAR DEEP LENS, MEDIUM DISTRIBUTION, MULTIVOLT, 4000K, 80CRI, 94.2 WATTS. MOUNTED AT 14'-0" AFF
F1	LITHONIA CAT. NO. DSXW1-LED-20C-1000-40K-T2S-MVOLT-PE-HS D-SERIES LED WALL LUMINAIRE, 20 LEDS, 1000mA DRIVE CURRENT, 4000K, TYPE 2 SHORT DISTRIBUTION, MULTIVOLT, BUTTON STYLE PHOTOCELL, HOUSE-SIDE SHIELD, 7204 LUMENS, 73 WATTS. MOUNTED AT 15'
E1	LITHONIA CAT. NO. LHQM-LED-R-HO / ELA-T-SD-Q-L0309 COMBO EXIT/EMERGENCY LED, WHITE HOUSING W/ RED LETTERS, 120/277V, 50' - 104' OPERATION, 90-MINUTE NI-CAD BATTERY, SELF-DIAGNOTICS, 4 WATTS, TWIN LED HEADS. MOUNTED AT 8' AFF. WIRE AHEAD OF SWITCH FOR LIGHTS SERVING AREA
E2	LITHONIA CAT. NO. EU2L EMERGENCY LED, WHITE HOUSING, 120/277V, 50' - 104' OPERATION, 90-MINUTE NI-CAD BATTERY, SELF-DIAGNOTICS, 4 WATTS. MOUNTED AT 8' AFF. WIRE AHEAD OF SWITCH FOR LIGHTS SERVING AREA
E3	HOLOPHANE CAT. NO. CZAFB-OEL-DDBTXD-UVOLT-LTP-SDRT-WT-CW ARCHITECTURAL EMERGENCY LED LIGHT FOR INDOOR/OUTDOOR USE, NORMALLY-OFF WITH INTERNAL LITHIUM ION PHOSPHATE BATTERY, DARK BRONZE TEXTURED, 120-347V, SELF-DIAGNOSTICS, WIDE-THROW, -30° - 50°C OPERATION. MOUNTED AT 8'



NOTES:
1) TOP OF FIXTURE AT 14'-0" ABOVE FINISHED FLOOR.
2) BLOWER ROOM: 20-25 AVG. FOOTCANDLES ON FLOOR.
3) ELECTRICAL ROOM: 30-35 AVG. FOOTCANDLES ON FLOOR.
4) MECHANICAL ROOM: 30-35 AVG. FOOTCANDLES ON FLOOR.
5) CONTRACTOR SHALL PROVIDE GROUNDING. BOND TO METAL FRAME AND MAIN DISTRIBUTION PANEL.

THE CITY OF Kalamazoo

BLOWER BUILDING
LIGHTING & GROUNDING PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
5		
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2		
1	REVISIONS AFTER ISSUED FOR BID	

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JOB NO. 017-7725.001
SCALE 3/16" = 1'-0"
THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
PEM	CJAF	AJD

STATUS: ISSUED FOR BID
DATE: FEBRUARY 2022

SHEET NO.
E-3
39 OF 44

KAL-77250(E)-BLOWER BUILDING LIGHTING & GROUNDING PLAN
1/27/2022 11:46 AM - SWILLIS
1/28/2022 2:53 PM

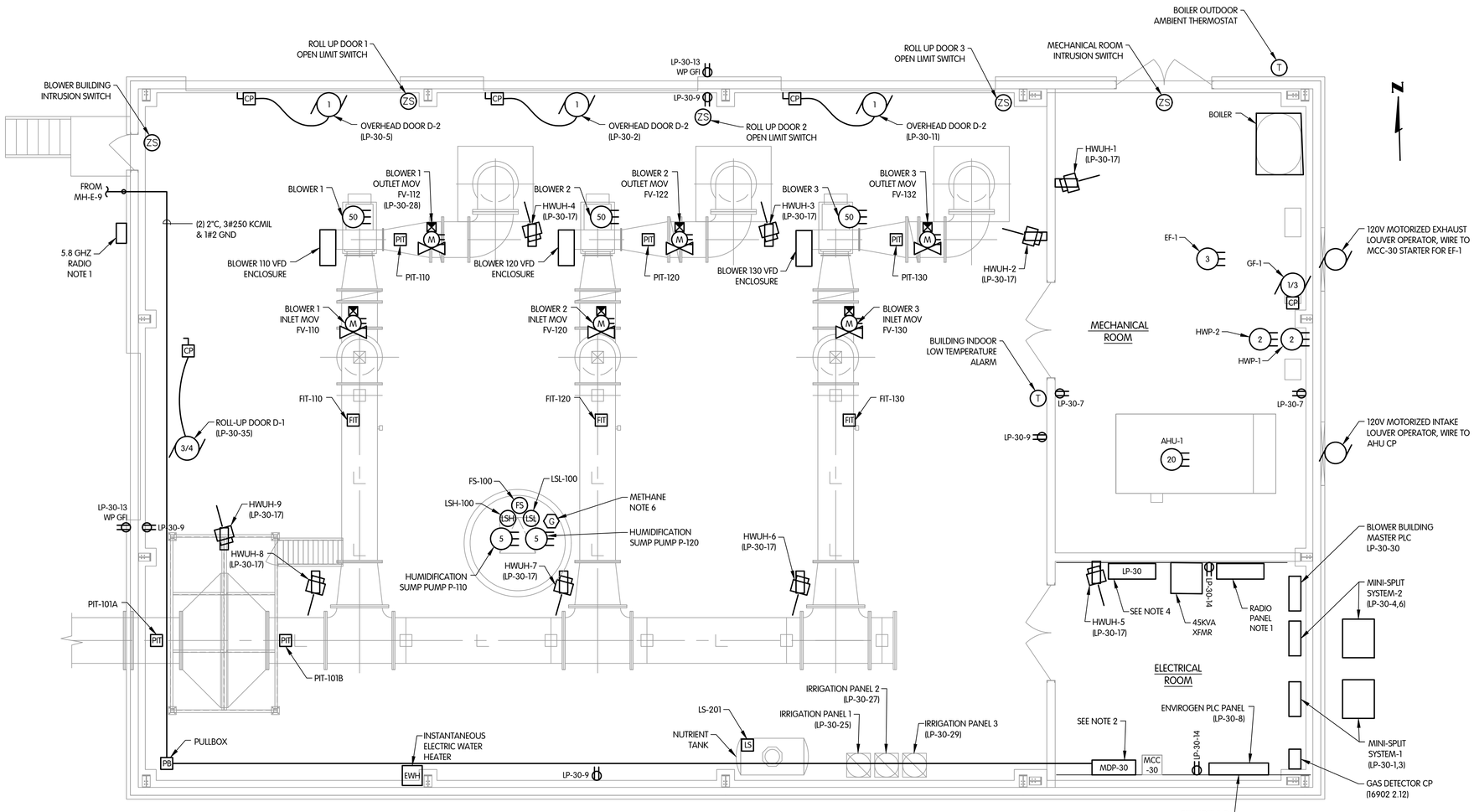
PANELBOARD DESIGNATION / TAG:		LP-30			LOCATION:		BLOWER BUILDING										
ELECTRICAL CHARACTERISTICS:		120/208V 3PH 4W			FEEDER SIZE:		175A - 4#2/0 & 1#6 Grd - 2"C										
PANELBOARD CONSTRUCTION:		CIRCUIT BREAKER			FED FROM:		MDP-30 VIA 45 KVA XFMR										
	AMP MAIN LUGS	10k	A.I.C. (FULLY RATED)				SURFACE	MOUNTING									
175	AMP MAIN BREAKER/SWITCH	100	% NEUTRAL (SOLID)				NEMA 12	ENCLOSURE									
42	AVAILABLE CIRCUIT SPACES	TOP	INCOMING FEED					MISC.									
'L'	After the circuit no. indicates handle locking device.																

		VOLT AMPS			CIRCUIT		WIRE SIZE		CIRCUIT		VOLT AMPS				
	LOAD DESCRIPTION	A	B	C	POLE	AMP			AMP	POLE	A	B	C	LOAD DESCRIPTION	
1	MINI SPLIT SYSTEM	2704			2	35	#8	#10	30	1	1920			OVERHEAD DOOR 2	2
3			2704				#8	#8	35	2		2704		MINI SPLIT SYSTEM 2	4
5	OVERHEAD DOOR D-2			1920	1	30	#10	#8					2704		6
7	MECHANICAL ROOM RECEPTACLES	800			1	20	#12	#12	20	1	600			ENVIROGEN PLC PANEL	8
9	BLOWER ROOM RECEPTACLES		400		1	20	#10	#8	20	1		734		EXTERIOR LIGHTING	10
11	OVERHEAD DOOR D-2			1920	1	30	#10	#12	20	1			1140	BLOWER ROOM LIGHTING	12
13	EXTERIOR RECEPTACLES	400			1	20	#8	#12	20	1	400			ELICTRIC ROOM RECEPTACLES	14
15	BIOFILTER 1 PIPING HEAT TRACE		600		1	20	#8	#12	20	1		206		ELECTRICALROOM LIGHTING	16
17	UNIT HEATER FANS (UH-1-9)			225	1	20	#12	#12	20	1			219	BIOFILTER LIGHTS	18
19	BIOFILTER 2 PIPING HEAT TRACE	600			1	20	#8	#8	20	1	280			SITE LIGHT POLES	20
21	SPARE				1	20		#8	20	1		600		BIOFILTER 3 PIPING HEAT TRACE	22
23	MECHANICAL ROOM LIGHTING			376	1	20	#12	#10	20	1			300	MAGNETIC FLOW TRANSMITTERS	24
25	WATER IRRIGATION PANEL 1	45			1	20	#12	#12	20	1	1000			RADIO PANEL	26
27	WATER IRRIGATION PANEL 2		45		1	20	#12	#8	20	1		600		BIOFILTER RECEPTACLES	28
29	WATER IRRIGATION PANEL 3			45	1	20	#12	#12	20	1			1500	BLOWER BUILDING MASTER PLC	30
31	GLYCOL PUMP	864			1	20	#12	#8	20	1	576			FV-110, 112, 120, 122, 130, 131	32
33	GAS DETECTOR		500		1	20	#12	#12	20	1		288		FV-211, 221, 231	34
35	ROLL-UP DOOR D-1			1440	1	20	#12	#12	20	1			288	FCV-214, 224, 234	36
37	SPARE				1	20		#8	20	1	576			FV-310, 312, 330	38
39	SPARE				1	20		#12	20	1		288		FCV-310, 320, 330	40
41	SPARE				1	20			20	1				SPACE	42
	SUB TOTAL VA	5,413	4,249	5,926							5,352	5,420	6,151	**SUB TOTAL VA**	
	PHASE TOTALS	**A**	**B**	**C**											
	TOTAL PHASE VA	10,765	9,669	12,077										**CONNECTED AMPS (Balanced)**	
	TOTAL PHASE AMPS	89.7	80.6	100.6										**PHASE DEMAND AMPS (Balanced)**	
	TOTAL CONNECTED KVA		32.511											**TOTAL DEMAND KVA**	

Circuit wire size(s) indicated are minimum allowable. Refer to wire sizing Table(s) and one-line diagram(s) on plan(s) additional information

Options: SUB-FEED LUGS; SUB-FEED BREAKER; FEED-THRU LUGS; SERVICE ENTRANCE RATED; 100% RATING

Options: MULTIPLE SECTIONS; YES SPD; BOLT-ON BREAKERS; MAIN TERMINAL LUGS



NOTES:
1) SEE SHEET E-8 FOR RADIO PANEL DETAILS AND MASTER PLC RISER DIAGRAM.
2) SEE SHEET E-6 FOR SINGLE LINE DIAGRAM.
3) SEE SHEET E-7 FOR ENVIROGEN PLC RISER DIAGRAM.
4) SEE PANEL BOARD SCHEDULE THIS SHEET.
5) H_2S AND COMBUSTIBLE GAS SENSORS MOUNTED AT 18" ABOVE FINISHED FLOOR.
6) METHANE GAS SENSOR MOUNTED TO BOTTOM OF ROOF STEEL AT ROOF PEAK.

THE CITY OF Kalamazoo

BLOWER BUILDING ELECTRICAL PLAN

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
1			
2			
3			
4			
5			

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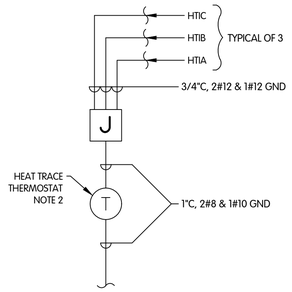
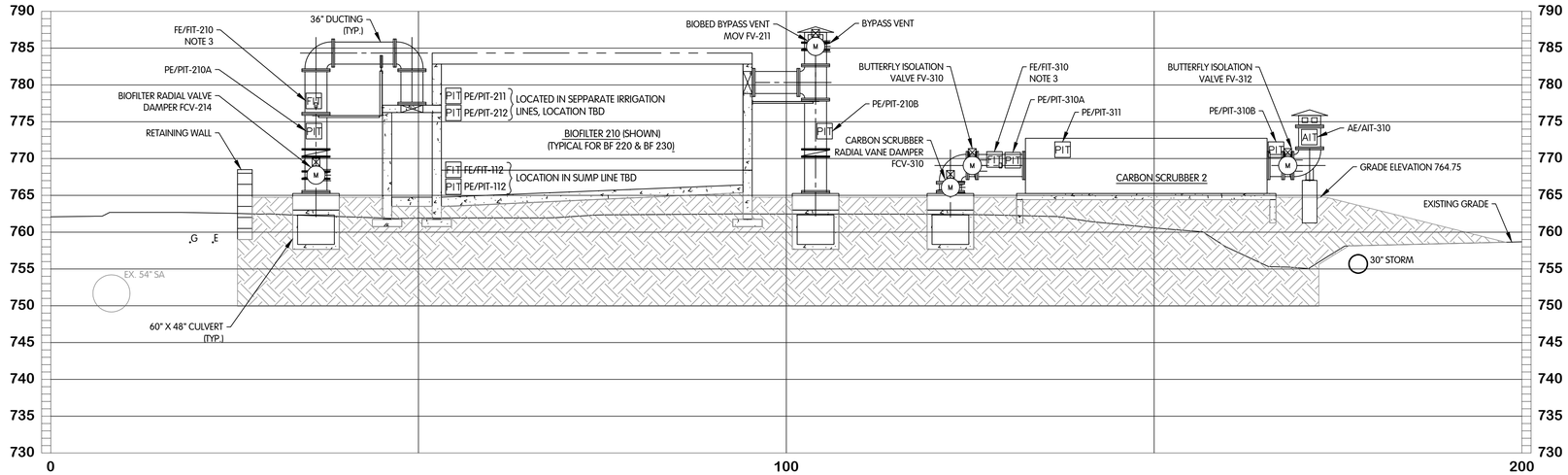
JOB NO.	017-7725.001
SCALE	3/16" = 1'-0"
	THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE
DESIGNED	PEM
DRAWN	CJAF
CHECKED	AJD
STATUS:	ISSUED FOR BID
DATE:	FEBRUARY 2022
SHEET NO.	E-4
	40 OF 44

K:\KAL-77250\E\E05-BLOWER BUILDING ELECTRICAL PLAN
2/10/2022 11:44 AM SWILLIS
2/10/2022 2:33 PM



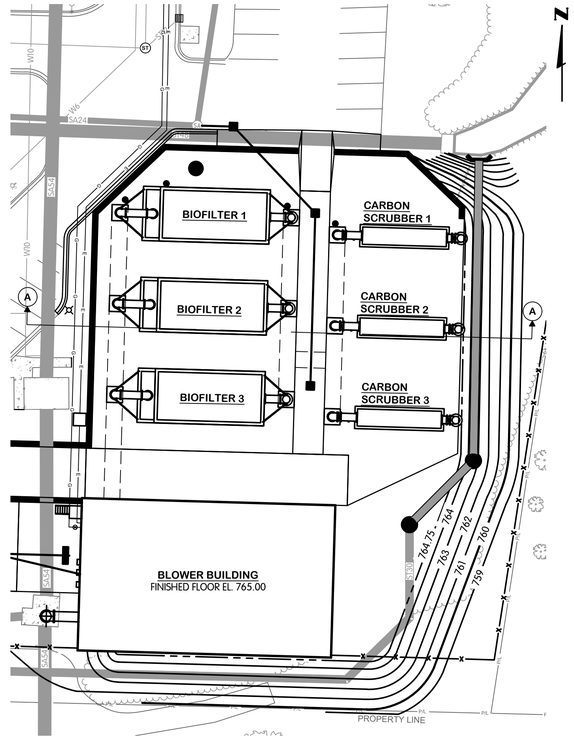
BIOFILTER HEAT TRACE RISER DIAGRAM

(BIOFILTER 210 SHOWN TYPICAL FOR BF 220 & BF 230)



SECTION A

NOTES:
1. SECTION APPLIES TO ALL BIOFILTERS AND CARBON SCRUBBERS.
2. HEAT TRACE THERMOSTAT FOR WATER PIPING FROM IRRIGATION PANEL SUMP (2@½") AND HUMIDIFIER SUMP (1@2"), ASSUME 25 FEET OF HEAT TRACED PIPE FOR EACH RUN.
3. VERIFY LENGTH OF DUCT STRAIGHT SECTION. FLOW METER INDICATED SHALL BE LOCATED AT APPROXIMATELY 80% OF THE DUCT LENGTH FROM THE DUCT SUPPLY END.



PLAN VIEW

1" = 30'

THE CITY OF Kalamazoo

BIOFILTER & CARBON SCRUBBER ELECTRICAL SECTION

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	BY
5		
4		
3		
2		
1	REVISIONS AFTER ISSUED FOR BID	

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JOB NO.	017-7725.001
SCALE	1" =10'-0"

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
PEM	CJAF	AJD

STATUS: ISSUED FOR BID

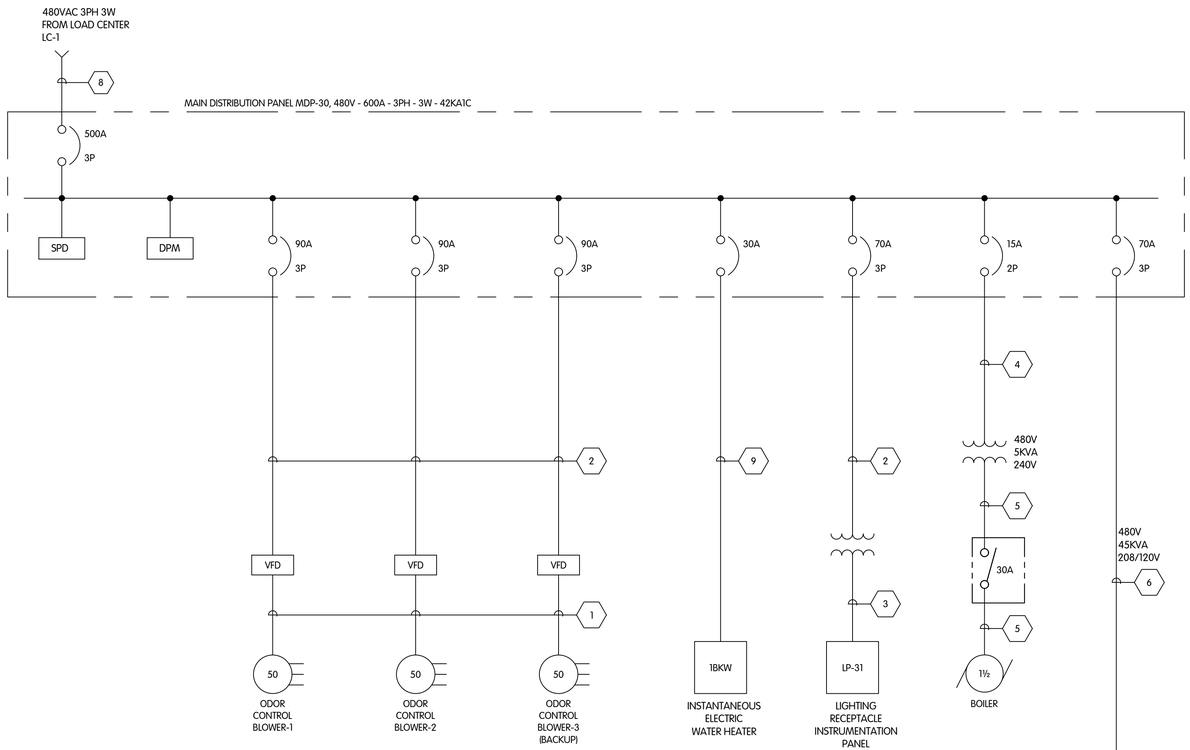
DATE: FEBRUARY 2022

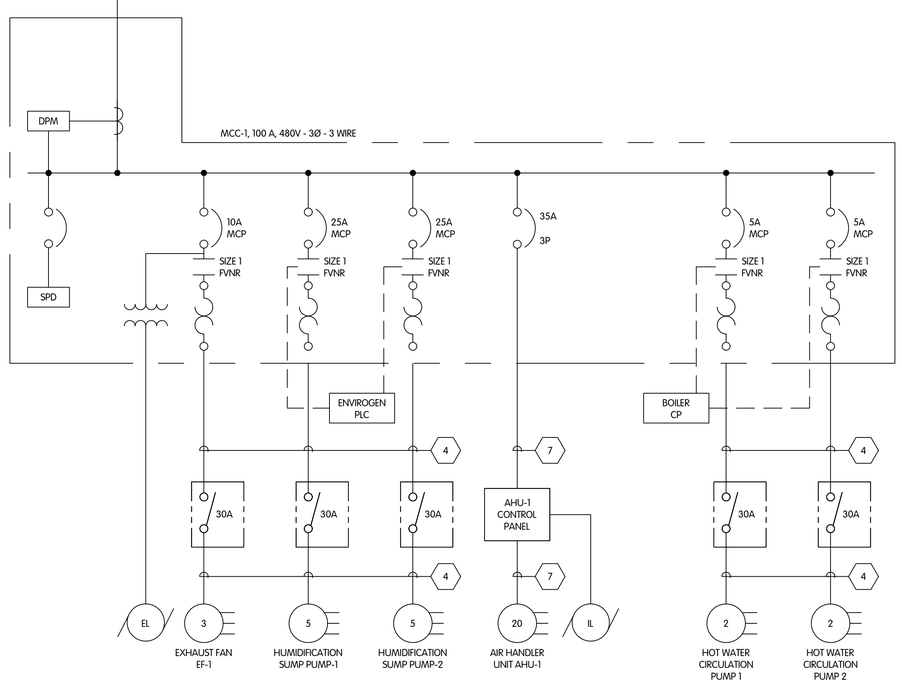
SHEET NO.

E-5

41 OF 44

KAL-77250\IE06-BIOFILTER & CARBON SCRUBBER ELECTRICAL SECTION
1/27/2022 10:40 AM - SWILLIS
1/28/2022 2:33 PM





CONDUIT AND WIRE SCHEDULE	
NUMBER	CONDUIT AND WIRE
1	2"C, VFD RATED 3/C#4 W/ 1#8 GND
2	1"C, 3#4 & 1#8 GND
3	2"C, 4#2/0 & 1#8 GND
4	¾"C, 3#12 & 1#12 GND
5	¾"C, 2#10 & 1#10 GND
6	1"C, 3#4 & 1#8 GND
7	¾"C, 3#8 & 1#10 GND
8	(2) 3"C, 3#500KCMIL & 1#2 GND
9	¾"C, 3#10 & 1#10 GND

THE CITY OF Kalamazoo

ONE LINE DIAGRAM

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

Jones & Henry Engineers, Ltd.

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JOB NO. 017-7725.001

SCALE NONE

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
PEM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

E-6

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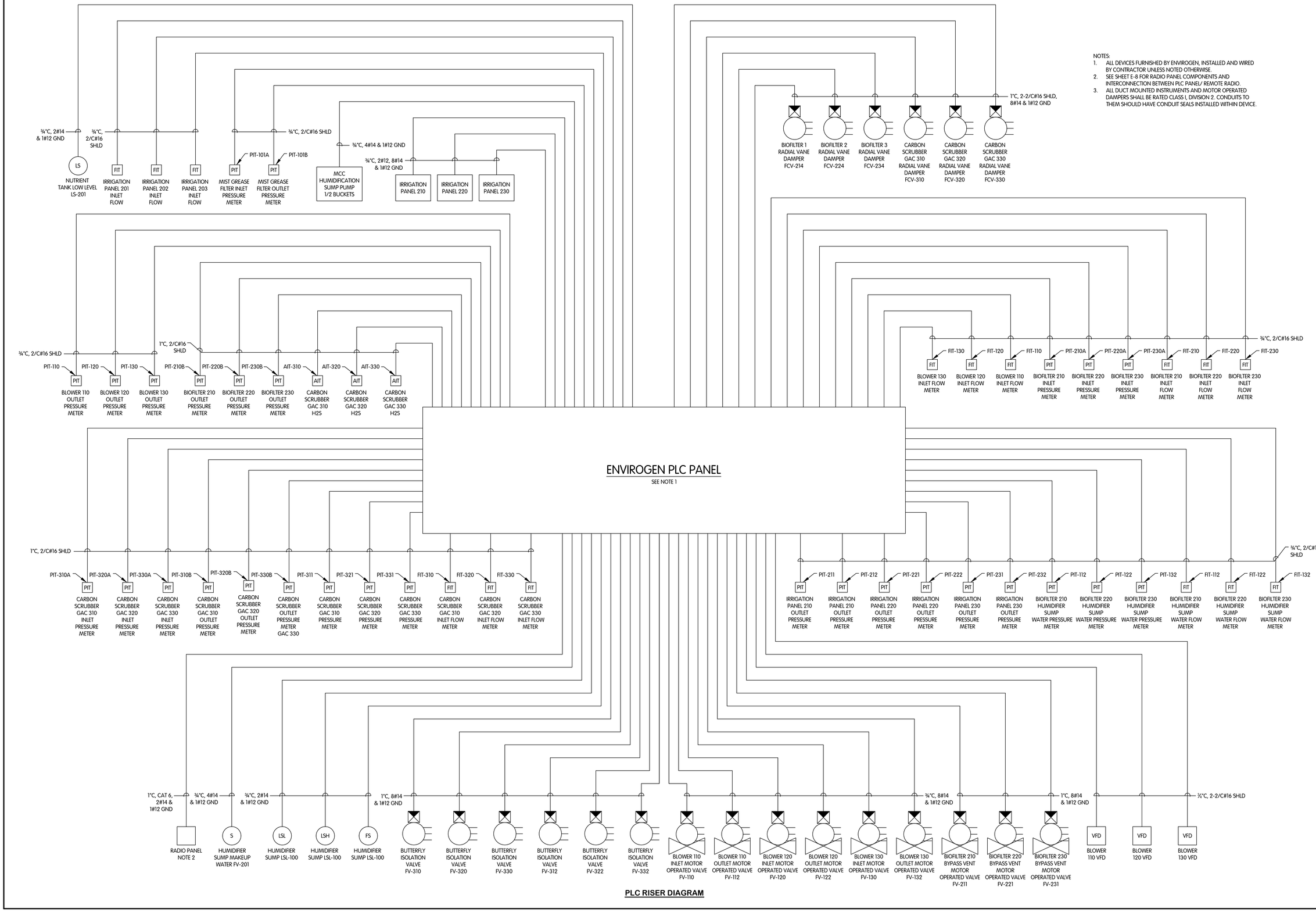
KAL-77250(IE)03-ONE LINE DIAGRAM
1/27/2022 10:40 AM - SWILLIS
1/28/2022 2:53 PM



PLC RISER DIAGRAM

THE CITY OF Kalamazoo

ENVIROGEN PLC RISER DIAGRAM

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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SCALE NONE

THIS LINE SCALES 1" WHEN PLOTTED TO NOTED SCALE

DESIGNED	DRAWN	CHECKED
PEM	CJAF	AJD

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.

E-7

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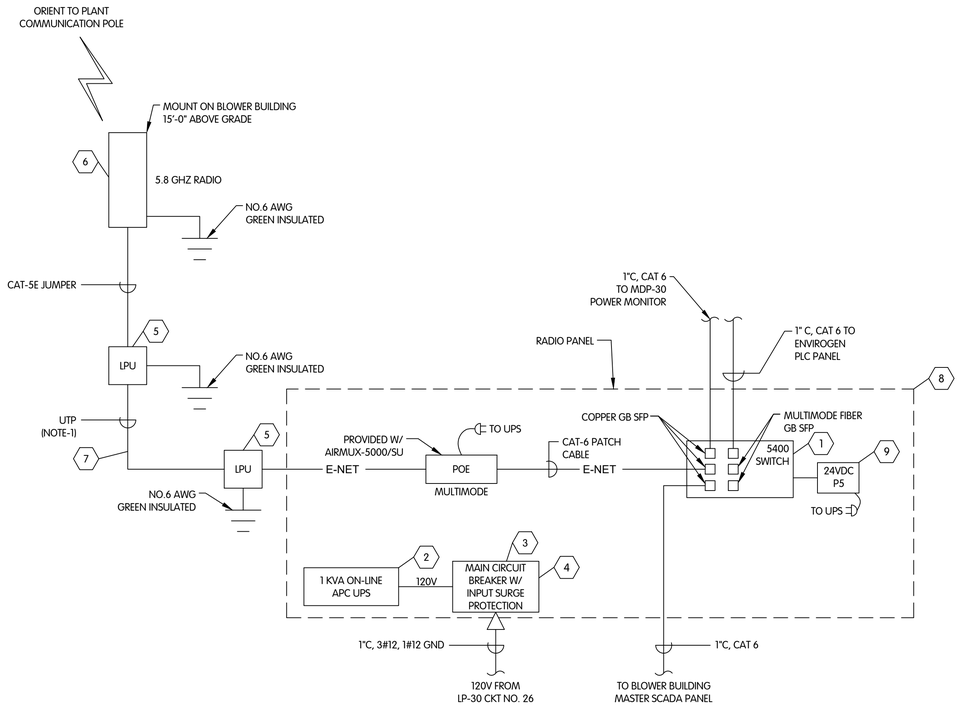
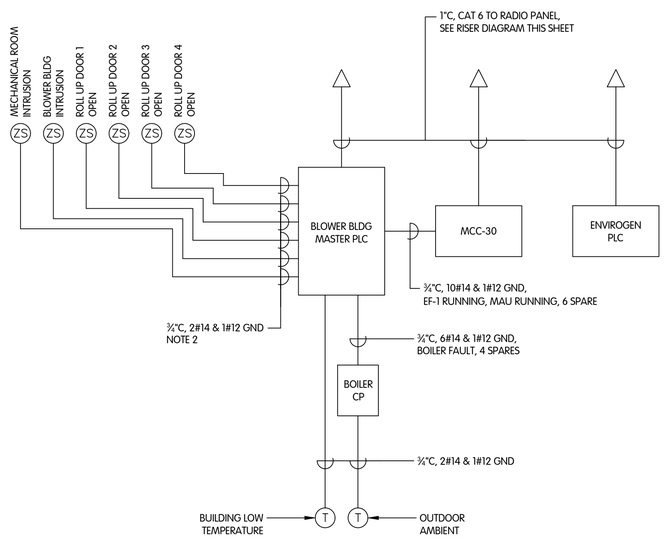
KAL-7725001E07-ENVIROGEN PLC RISER DIAGRAM
Last Saved By: JAMES - SWILLIS
1/28/2022 2:33 PM

ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	1783-HMS8TG4CGR	ROCKWELL STRATIX 5400 4-GB SFP 8-COPPER PORTS LAYER 3 SWITCH
2	1	BR1000G	1KVA ON-LINE APC UPS
3	1	1489 M-SERIES	ROCKWELL 15A BREAKER
4	1	4983-DC12020	ROCKWELL INPUT SURGE PROTECTION
5	2	AIRMUX-OUTDOOR-LPU-KIT	OUTDOOR LIGHTING PROTECTION UNITS FOR 10/100/1000BASE-T POE SURGE PROTECTOR (INCLUDING 0.5M CAT5E CABLE AND WALL/POLE MOUNTING KIT)
6	1	AIRMUX-5000/SU-PRO/F58F/100M/EMB	SU-PRO 100 ODU, WITH AN INTEGRATED ANTENNA, SUPPORTING MULTI FREQUENCY BANDS AT 5.X GHZ, FACTORY DEFAULT 5.8 GHZ FCC
7	NOTE-1	AIRMUX-UTP/100	100m UNSHIELDED TWISTED PAIR
8	1	SCE-30H3012LP	SAGINAW 30"x30"x12" DEEP NEMA 12 ENCLOSURE
9	1	1606-XLE240E	ROCKWELL 24VDC POWER SUPPLY

NOTES:
1. 100m CABLE LENGTHS SHOWN. REVISE TO SUIT PROJECT. AVAILABLE LENGTHS: 100m, 75m, 50m, 25m. PROVIDE FIBER TO COPPER MEDIA.
2. PROVIDE 24VDC POWER SUPPLY IN BLOWER BUILDING PLC PANEL FOR DOOR / ROLL UP DOOR SWITCHES.



RADIO PANEL RISER DIAGRAM



BLOWER BUILDING PLC RISER DIAGRAM

THE CITY OF Kalamazoo

BLOWER BUILDING ELECTRICAL RADIO COMMUNICATION DIAGRAM

KWRP BIOFILTRATION - CONTRACT 76 - KALAMAZOO, MICHIGAN

NO.	DATE	REVISIONS AFTER ISSUED FOR BID	BY
5			
4			
3			
2			
1			

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SCALE NONE

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DESIGNED	DRAWN	CHECKED
PEM	CJAF	PEM

STATUS: ISSUED FOR BID

DATE: FEBRUARY 2022

SHEET NO.
E-8
44 OF 44

K:\KAL-7725\01\E08-BLOWER BUILDING ELECTRICAL RADIO COMMUNICATION DIAGRAM
11/27/2021 11:44 AM - S.WILLIS
11/29/2021 2:31 PM
XREFERENCED FILES: